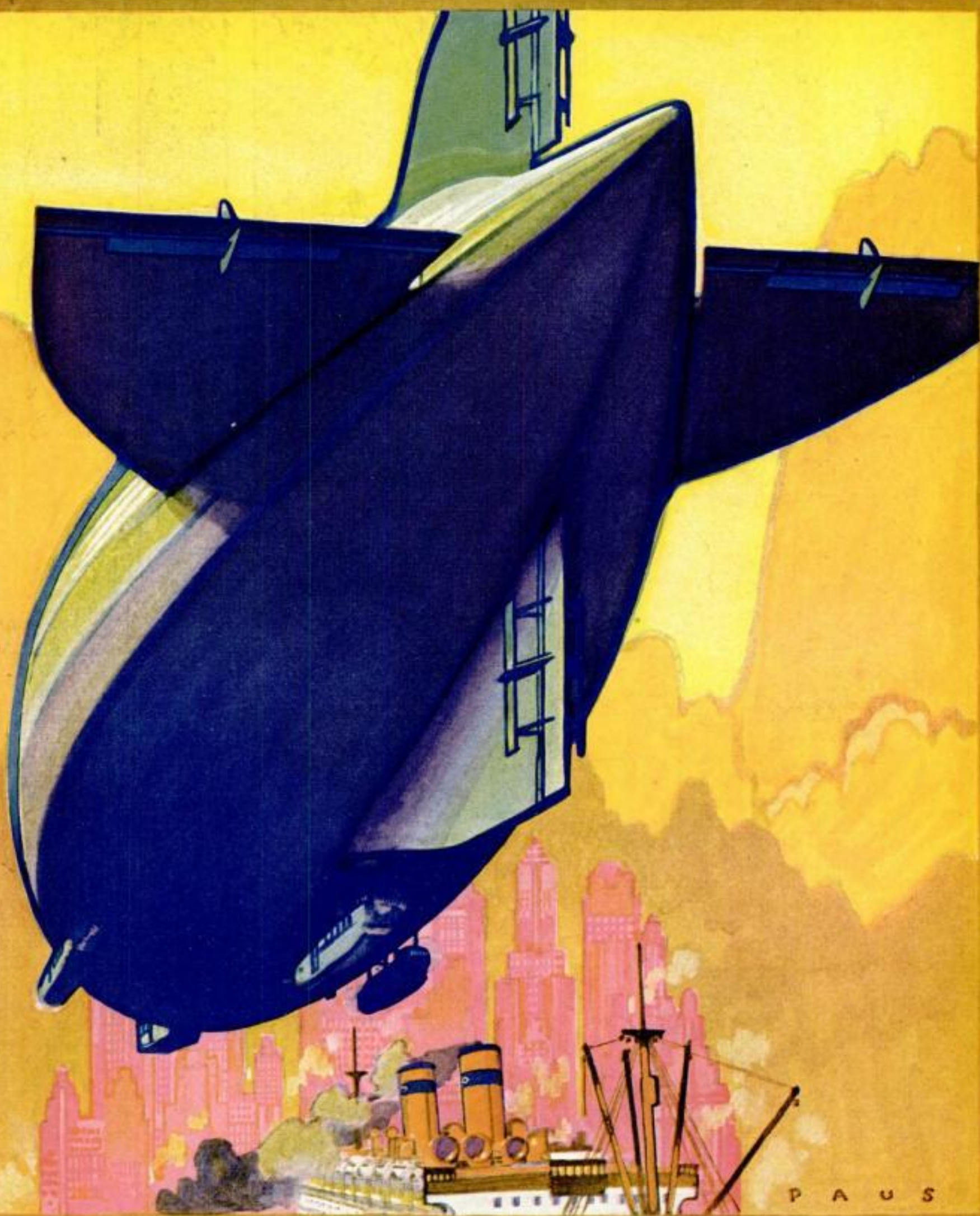


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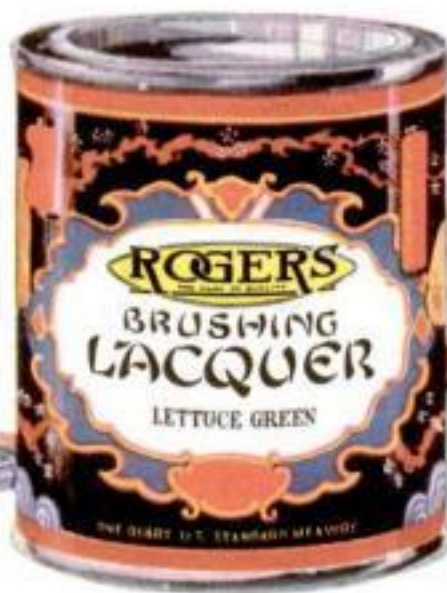
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WHAT IS NEW THIS MONTH

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How to Quit Worrying Over Money Matters

By WALLACE AMES, Financial Editor

"I'M GLAD I've got a good job," thought Warren Cady, as he stayed overtime at the office the afternoon of pay-day to go over his bills and draw checks to cover them.

Let's look over Warren's shoulder and see what his monthly crop of bills is. Here is the itemized list of the checks he drew:

Monthly mortgage and interest payment	\$ 83.33
Gas, electricity, milk, etc.	21.32
Mrs. Cady's monthly allowance	100.00
Mr. Cady's personal miscellaneous	50.00
Installment on automobile	41.20
Installment on radio	8.00
Installment on set of books	3.50
Installment on electric refrigerator	12.50

Total disbursements \$319.85

As Warren had deposited in the bank a salary check of \$416.66 he had increased his bank balance \$96.81 after paying the month's bills and drawing out the usual amount used by his wife and himself for current expenses. With a feeling of relief that an annoying job was attended to he pulled the day's sheet off his calendar pad as the last act before closing down his desk and starting for home.

GLANCING at the notes on the calendar for the next day, Warren was reminded that his semi-annual premium payment on life insurance amounting to \$60.00 was due. "Something is always taking the joy out of life," he burst out. "Just when I was enjoying the satisfaction of increasing my bank balance with a hundred dollars this insurance premium has to come due and eat up over half of it." After drawing another check Warren caught the 6:19 for home. His wife met him at the station as usual. As they passed the house of a neighbor the undertaker was just leaving and a crepe was hanging on the front door.

"That must mean that Bill didn't rally," observed Warren. "My, I'm sorry. He was such a good scout, such a good neighbor and always so good to his wife."

"It will certainly be hard on Mary," said Mrs. Cady. "When I was in yesterday afternoon there was only a slight hope for Bill's recovery. I must run in tomorrow morning and see what I can do to help. Poor thing. I'm so sorry for her."

The neighbor's misfortune was very much on the Cadys' minds that very evening.

Aside from being sympathetic their thoughts began to speculate somewhat on Mary's future. "Wonder what Mary will do," said Warren. "They bought their car about the same time we did. There must still be six or seven payments to make on it. And that house with its mortgage payments to meet. How will she get along?"

"I don't know," was the best answer Mrs. Cady had to offer. "Her folks are fairly well to do and they are devoted to little Bill. It wouldn't surprise me if she goes to live with them. I'll be sorry to see her go."

"That reminds me," said Warren. "I just paid the monthly bills today. Here is your check. What do you suppose you would do if I didn't come home once a month with a handful of shekels?"

Then, without waiting for the answer, for there was really no good answer to Warren's last question, he began to do a little figuring. He computed that there were seven more payments on the car, amounting to \$288.40; four radio payments of \$32; five book payments, \$17.50 and six remaining refrigerator payments totalling \$75.

Everything that the Cadys were buying "on time" was a sensible, worthwhile thing, from which they derived a lot of deserved satisfac-

tion and pleasure. Nevertheless it worried Warren when he figured up a total of \$412.90 that had to be paid before the auto, refrigerator, radio and books were really theirs.

BUT those items were only a drop in the bucket. There were the mortgages on the house. While it was a good investment, something like \$5,000 was still to be paid over a period of the next seven or eight years.

And then there was little Warren, Jr., their two-year-old son. They had spent many an hour talking and dreaming over his future. Of course they were planning to send him to college. And his daddy had visions of Junior making the football team.

(Continued on page 5)

A Service for Readers

THIS Financial Department is to help readers in the establishment of proper financial programs at the beginning of their business careers; it assists those who have accumulated money in the proper investment of it.

The Editor of this Department is an authority on investment matters. He is ready to aid in personal investment problems. Advice will be gladly given regarding the proper investment of funds and proper plans of saving.

Address your inquiries to Wallace Ames, Financial Editor, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York. While investments obviously cannot be guaranteed by the Publisher, every effort will be made to insure that only advertisements of absolutely reliable companies are accepted.

How to Quit Worrying Over Money Matters

(Continued from page 4)

"Yes," said Warren, at the close of the evening. "I'm glad I've got a good job—and my health."

"I saw Mary today," remarked Mrs. Cady, when she met her husband the next evening at the train. "She is a courageous soul and is bearing up better than I expected she would."

"While I was there the insurance man called. His visit was just like the silver lining, if there could be such a thing to the cloud that hangs over her just now. He was there to settle up three insurance policies and I was so pleased to learn how well fixed financially Mary is. Last night you remarked how good Bill had always been to Mary. I thought of what you said when the insurance representative was there."

"One policy for \$2,000 was arranged to help put little Bill through college. That is still a long way ahead. That money invested will probably be more than enough. It will buy his clothes and take care of a lot of things while he is growing up."

"Another policy will pay Mary \$5,000 right away. It will take care of all her extra expenses at this time and pay off the mortgage on their home. So she hasn't got that to worry about."

"From the third policy Mary will be paid \$125 income every month. She is a good manager and can get along very comfortably on that amount. Bill sure was good to Mary."

"That was certainly far-sighted of Bill to carry all that insurance," said Warren, "but he must have had an awful time keeping up his premium payments. I find it a painful struggle keeping our \$5,000 policy in force. Wonder how much he was paying out for insurance?"

"We manage to pay over \$40 every month on our automobile," suggested Mrs. Cady.

"That's a thought," replied her husband. "Do you know, I never had the gumption to think of it in that way. We readily pay for the car and the radio and the refrigerator because we are using them all the time, getting our pleasure out of them as we go along, and the necessary monthly payments seem even easier than the semi-annual insurance payments. My point of view has just been wrong."

"I THINK I will see my insurance agent tomorrow and work out a new program. Then I can quit worrying over what would happen to you if I should unexpectedly join Bill. We can extract enough money from our bank account to pay the initial premium. Before the next one comes due we will be through paying for the car and we can thereafter use that money to carry enough insurance to protect you against any financial hardships."

Warren Cady kept his good resolution. The next day he and his insurance agent worked out a sound, practical program along these lines:

I. Warren Cady's present policy was on the 20-payment life plan taken out 9 years before—when (Continued on page 6)



THE PHOENIX MUTUAL LIFE INSURANCE COMPANY

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Here's 10c (stamps or coin). Send big tube of MOLLÉ to

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How to Quit Worrying Over Money Matters

(Continued from page 5)

he was twenty-six years old. After deducting dividends, premiums on this policy were about \$115.00 a year. When he reached age 46, he would cease paying premiums on this policy.

In the new program Warren's 20-payment life policy was left untouched to provide Mrs. Cady with \$5,000 in cash to take care of current expenses, mortgages, etc. In insurance parlance this is referred to as a clean-up fund.

II. A \$2,000 20-year endowment policy was arranged with his son as beneficiary.

IT WAS planned to allow dividends to accumulate on this policy so that it would actually pay over \$2,000 seventeen years hence. Thus in case Mr. Cady should survive the seventeen years, the insurance would provide cash for educational expenses. Provision was made whereby in the event of Mr. Cady's death before the endowment policy matured, the insurance company would hold the principal and pay interest to Mrs. Cady as guardian until the son was eighteen years old and then pay the principal to him in eight semi-annual installments. Thus, before and after entering college, funds would be provided for the boy's expenses.

III. Additional ordinary life policies aggregating \$18,400 were taken out. These policies provided Mrs. Cady with a guaranteed income of \$100 a month for twenty years after Mr. Cady's death. Together with the average excess interest paid the average total monthly income payments would be approximately \$113.50. They also contained a clause whereby if Mrs. Cady should live more than twenty years after Mr. Cady's death, she would receive an income of \$100 a month after the twentieth year.

IV. On all the insurance, except the \$2,000 endowment, it was planned to use dividends to help pay premiums. These dividends would commence the second year of the new policies. Whereas the first year total premium payments would be \$786, beginning the second year they would amount to only \$654.

BY TAKING out a number of small policies rather than one large one, Mr. Cady's insurance representative arranged it so that premium payments would come due monthly rather than in a large sum once or twice a year. The average monthly premium payment beginning the second year was only about \$55, in return for which Mrs. Cady was assured of \$5,000 cash, plus \$100 monthly income, and Warren, Jr., was assured of \$2,000 at age eighteen, plus income on that sum in the interval, subsequent to Mr. Cady's death.

When Mr. Cady reached age forty-six, he would cease paying premiums on his \$5,000 20-payment life policy. Thereafter his monthly premiums would be reduced to an average of \$40.

One of the most interesting things about Warren Cady's new insurance program was his point (Continued on page 7)

The Highest Paid Effort



in the World

**Clipping coupons. Learn the
joy of it. Open to everyone.**

Every clip-clip of the shears means three dollars semi-annually (six dollars a year) on each hundred you invest in good 6% First Mortgage Bonds. A big return for a little effort.

You need not be a millionaire to enjoy the sport of clipping coupons. Thousands are buying Fidelity First Mortgage Real Estate Gold Bonds on a Monthly Savings Plan that earns 6% from the start. And such investment is absolutely safe.

Without obligating yourself, let us tell you more about our Savings Plan and what is behind the bonds we offer. Write, today, for the interesting, instructive booklet, "The House Behind the Bonds."

**FIDELITY
BOND & MORTGAGE CO.**

111 N. MICHIGAN, DETROIT, MICH. INCORPORATED 1923

660 Chemical Bldg., St. Louis
1188 New York Life Bldg., Chicago
378 Colorado Nat'l Bank Bldg., Denver
FIDELITY • GUARANTEES • EVERY • BOND

**As regularly
as the months
Roll by**

**GUARANTEED
6%
UNITED
FIRST MORTGAGE
BONDS**

As regularly as the time for payment comes, holders of United First Mortgage Bonds receive their interest checks. No doubt—no uncertainty—no sleepless anxiety over possible fluctuations in value.

United Bonds are safe. Payment of interest and principal is guaranteed by the oldest exclusive first mortgage bond company in Michigan, a company with resources of more than twenty million dollars.

You can buy United Bonds in amounts to suit individual needs—on partial payments if desired. A few dollars will start you.

Mail the coupon today for complete information.

**UNITED STATES
MORTGAGE BOND CO.**

Howard C. Wade, President

365 U. S. Mortgage Building, Detroit, Michigan

UNITED STATES MORTGAGE BOND CO.

365 U. S. Mortgage Building, Detroit, Michigan

Gentlemen: Please mail copy of your booklet, "The Habit of Success".

Name.....
Address.....
City.....State.....

Here is the ANSWER

to questions which
bother many investors

How can you tell what gives a first mortgage bond absolute safety?

How can you get the highest income from your money, consistent with safety?

How can you select a safe investment house?

How can you retire in 15 years on your present living budget?

How can you get double the savings bank interest rate or more, with all the convenience?

How can you judge the security back of a first mortgage bond?

What is the history of the first mortgage bond in Chicago?

Why can Cochran & McCluer sell first mortgage bonds in every state of the Union without salesmen?

All of these questions and many others vital to investors are answered in the new edition of a famous book, "Behind the Scenes Where Bonds Are Made." Get your copy now. We'll gladly send it. No salesman will call.

P.S.M. 10-28
Cochran & McCluer Co.
46 North Dearborn St.
Chicago, Ill.

Gentlemen: Please send me without obligation your book, "Behind the Scenes Where Bonds Are Made." No salesman will call.

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Address _____
City _____ State _____

Cochran & McCluer Co.
Established 1881
Never a loss to any investor
46 NORTH DEARBORN STREET
Chicago

How to Quit Worrying Over Money Matters

(Continued from page 6)

of view towards payments. Once he got the right idea it was just as easy to pay \$55 a month in insurance premiums as to pay a similar amount in installments on mortgages or merchandise.

To Help You Get Ahead

THE Booklets listed below will help every family in laying out a financial plan. They will be sent on request.

"Ideal Investments" is the designation universally accorded Smith First Mortgage 6½% Bonds which carry attractive tax refund features. A history of the House and information relative to their bonds and the safeguards that surround every issue they offer may be obtained by addressing the home office of The F. H. Smith Company, Smith Building, Washington, D. C.

The House Behind the Bonds reminds the investor of the importance, not only of studying the investment, but of checking up the banker who offers it. Address: Fidelity Bond & Mortgage Co., 1888 New York Life Building, Chicago, Ill.

"The Investment Trust from the Investor's Viewpoint," presents an explanation of this form of investment in easily understood terms, illustrated with some interesting examples of how the general investment trust will help the man with \$100 or more to get ahead. Published for free distribution by United States Fiscal Corporation, 50 Broadway, New York. Ask them for Booklet IT.

How to Retire in Fifteen Years is the story of a safe, sure and definite method of establishing an estate and building an independent income which will support you the rest of your life on the basis of your present living budget. Write for the booklet to Cochran & McCluer Company, 46 North Dearborn St., Chicago, Ill.

How to Get the Things You Want tells how you can use insurance as an active part of your program for getting ahead financially. Phoenix Mutual Life Insurance Company, 328 Elm Street, Hartford, Conn., will send you this booklet on request.

The Guaranteed Way to Financial Independence tells how a definite monthly savings plan will bring you financial independence. Write for this booklet to Investors Syndicate, 100 North Seventh Street, Minneapolis, Minn.

The Making of a Good Investment tells how 6½% can be made on investment in First Mortgage Bonds in units of \$50, \$100, \$250, \$500 and \$1000; how the bonds are protected and how simple it is to purchase them. For a copy of this booklet address United States Mortgage Bond Company, Limited, Detroit, Michigan.

With his wife's future, adequately, provided for and Junior's education assured Warren Cady had a peace of mind he never before had enjoyed. And now that he no longer had to worry over money matters Cady found that he attacked his work at his office with renewed vigor that brought better results.

Will History Repeat?

Early in 1925 investors were offered the opportunity to purchase shares in Financial Investing Co. of New York, Ltd., a general investment trust under management of United States Fiscal Corporation.

Between April, 1925, and April, 1928, an investment of \$1550 in 100 shares returned a cash profit of \$470 and the investor could have sold his stock at a market profit of \$875—a total three-year profit of \$1345 on \$1550 invested.

Two Dividend Increases Plus Extras

The initial dividend rate of 10% was increased to 12% July 1, 1927, and to 16% July 2, 1928. Six extra cash dividends have also been paid, making total payments on the \$10 par value shares as follows:

Year Ended	Regular	Extra	Total	Current Price of Shares
April 1, 1926 . . .	10%	2%	12%	\$18.50
April 1, 1927 . . .	10%	3%	13%	20.00
April 1, 1928 . . .	12%	2%	14%	26.25
July 2, 1928 (3 mos.)	4% (annual rate 16%)			28.25

You May Now Invest In SECOND FINANCIAL INVESTING CORPORATION

All the shares of Financial Investing Co. of New York, Ltd., having been sold at prices increasing from \$15 to \$28.25 per share, United States Fiscal Corporation now offers you shares in Second Financial Investing Corporation.

Since these two investment trusts are under the same management and alike in major particulars, it is anticipated that history will repeat itself, the new trust duplicate the success of the old and pay similar profits to shareholders.

You now have the opportunity to become an original stockholder—to invest \$100, \$500 or any larger amount in Second Financial Investing Corporation before any substantial increase in price occurs.

Learn How to Make Big Profits Conservatively

It is all explained in our booklet, "The Investment Trust—from the Investor's Viewpoint," and in literature describing Second Financial Investing Corporation. Mail the coupon and profit by reading this free literature.

UNITED STATES FISCAL CORPORATION

Managers of
Second Financial Investing Corporation
and
Financial Investing Co. of New York, Ltd.



United States Fiscal Corporation
50 Broadway, New York

Please send me, immediately, your free booklet that tells how I can invest for financial independence.

Name

Address 10 PS

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Do Your Radio Tubes Last?

Life of Tubes Is One of the Features That Is Determined in Institute's Tests

By

Alexander Senauke, M. E., E. E.

Assistant Director

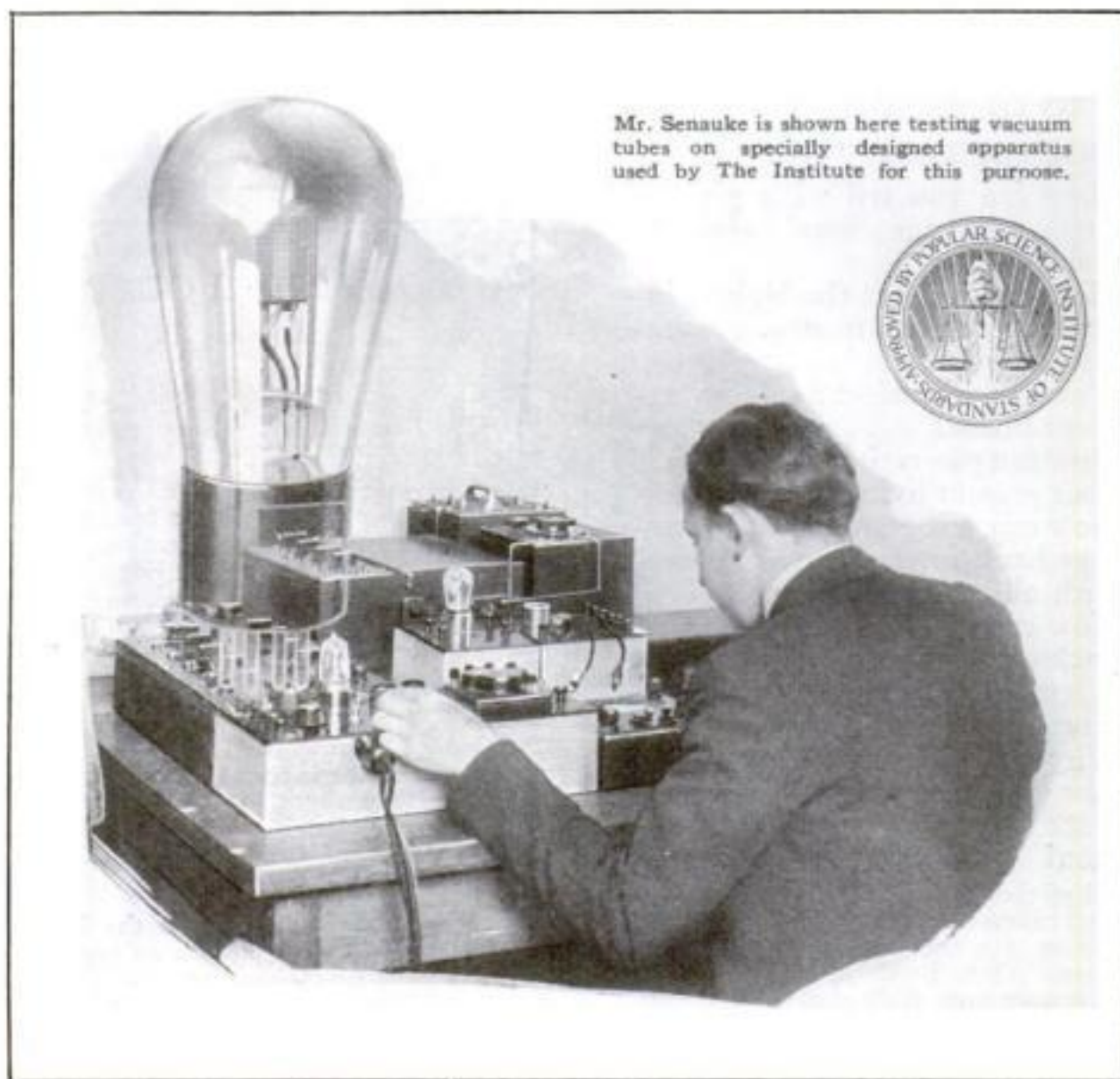
Popular Science Institute of Standards

IF FEW people recognize just how important is the work of vacuum tubes, they all do realize that the life of these radio essentials is often entirely too brief. The causes for the short life of some tubes have been definitely determined, but let us see what the vacuum tube does while it is living.

Everybody is enjoying the fine tone of the radio sets now on the market and remarking over the convenience of connecting up directly with house current supply. Credit is rarely given the little vacuum tube for these pleasures. As a matter of fact, however, it was the development of new types of vacuum tubes that preceded and inspired these major changes and improvements.

Superior tone quality in receiving sets was brought about to a very great extent through the use of power output tubes, such as the 171, 210 or 250 types. Special purpose detector and amplifier tubes have made possible the reception of more distant stations or greater volume. "B" batteries have been satisfactorily eliminated through the development of rectifier tubes of the gas and filament types. A new screen grid type of vacuum tube which has just been developed is expected to play a large part in simplifying the attainment of distance-getting ability and stability of radio sets.

And, complete electric operation is now popular thanks to new tubes in



Mr. Senauke is shown here testing vacuum tubes on specially designed apparatus used by The Institute for this purpose.

which the electron emission is obtained by the direct application of alternating current to filament or heater.

Because of the difference in the operating characteristics of these various types of tubes, and because of the difference in their mode of operation, the regular Institute tests on vacuum tubes have had to be modified or supplemented by special tests to bring out the necessary facts regarding these tubes and to determine if they are capable of satisfactorily doing their intended work.

For instance, in the case of the A. C. tubes such as the 226, the very feature of design that makes for a minimum of A. C. hum will result in the short life of the tube unless the manufacturer has taken proper precautions with regard to the special handling required for this type of tube. To cut down the hum, they use in the 226 tubes a bulky oxide coated filament that holds the heat so well that the rapid changes in alternating current do not affect its temperature. This necessitates special care and processing to assure proper evacuation and prevent impairment of the oxide coating, since any gas formation or loss of emission means that the tube will be short-lived.

Therefore, in investigating tubes of this type, special tests were arranged by the Popular Science Institute of Standards to check the presence of gas and the condition of the filament, so that approval would be granted only to those tubes having good life possibilities.

Then, with the heater type of A. C. tubes of the 227 or Kellogg types, the

great amount of heat generated in the tube may, with improper design or manufacture, cause gas occlusion from the elements of the tube and sometimes even undesired electron emission from the grid. Such emission and gas seriously interfere with the proper operation of these tubes as well as shortening their life. To make sure that such tubes are properly constructed, means that they must be put through special tests.

Of course, in the case of all vacuum tubes, it is necessary to test all general characteristics to make sure that they conform to accepted standards, besides the additional tests mentioned above that are made to determine the special characteristics of certain types of tubes.

The requirements for approval of the Popular Science Institute of Standards are such that all tubes on the approved list are interchangeable for their intended uses and are of such construction and efficiency that they will insure the best performance of the receiving sets or accessories in which they are used.

The new Fall edition of The Institute's *List of Approved Radio Products* is just out and may be had free on request. Readers who are selecting radio equipment will also find very helpful the booklet *What the Radio Buyer Should Know*. There is a charge of twenty-five cents for this latter booklet, which gives in twenty-two pages all the essentials that should be kept in mind in buying, installing and operating a radio outfit. Address the Popular Science Institute, 250 Fourth Ave., New York, N. Y.



Popular Science Monthly GUARANTEE

The above seal on an advertisement indicates that the products referred to have been approved after test by the Popular Science Institute of Standards.

POPULAR SCIENCE MONTHLY guarantees every article of merchandise advertised in its columns. Readers who buy products advertised in POPULAR SCIENCE MONTHLY may expect them to give absolute satisfaction under normal and proper use. Our readers in buying these products are guaranteed this satisfaction by POPULAR SCIENCE MONTHLY.

THE PUBLISHERS

This genuine wood board is grainless and won't check or split!

Possesses uniform strength and remarkable workability. Highly resistive to moisture. Very tough and dense. Has a smooth, attractive surface on the face side, and requires no paint for protection. Also takes any finish beautifully. Send for large, free sample.



FOR PANELING

A decade ago no one ever dreamed that there would be such a thing as *grainless* wood. Yet it has now been on the market for more than two years, and new uses are being discovered for it right along.

The name of this product is Masonite Presdwood. And remember that Presdwood is *all wood*; genuine wood torn apart and put together again.

Presdwood will not crack, check, split or splinter. It shows minimum contraction and expansion under the most severe working conditions. Stoutly resistive to moisture and to sudden changes of temperature, it is practically immune to warping, shrinking, swelling, buckling.

It cannot damage tools

Presdwood contains no grit, no resin, no foreign matter of any kind. It cannot damage tools. Convenient and easy to handle it also eliminates waste in cutting. And it frequently reduces the number of manufacturing operations.

Presdwood has a very smooth, attractive surface on the face side and requires no paint for protection. It also takes any finish beautifully: lacquer, paint, stain or varnish.

Another one of the outstanding advantages of Masonite Presdwood is that it can be used on any woodworking machinery, and possesses amazing workability. In fact, it is so widely adaptable

that the number and versatility of its uses seem to be unlimited.

These uses include signs, both outside and inside; cut-outs of all kinds; breakfast nooks and kitchen cabinets; closet lining and display booths; paneling, interior finish and office partitions; radio boxes; showcases, show window flooring, store fixtures and table tops; bedroom screens and fire screens; toys, tension boards for radio speakers and portable billiard tables; Sager boards for potteries; forms for reinforced concrete; truck bodies; motor boat hulls.

Where next?

Where will Presdwood be used next? Nobody knows!

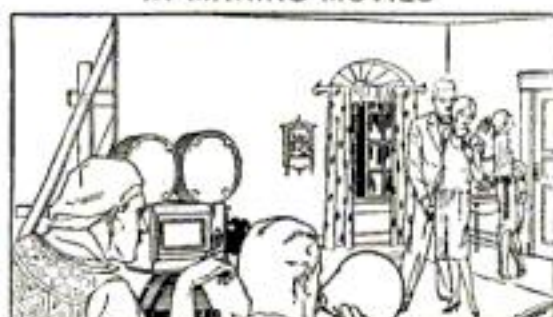
Within the past few months it has gone into the making of cooling trays for hot castings, incubators, clothes hampers, work-bench tops, starch trays for candy-making, flower boxes, doll houses and concrete forms.

And just recently it has come into demand for cafe nooks and for the fences of baseball parks! Thus you see that there is really no limit to the uses for Presdwood. Write for a free sample and find out what it will do for you.

MASON FIBRE COMPANY

Sales Offices: Dept. 1210-8, 111 W. Washington Street
Chicago, Illinois

IN MAKING MOVIES



Mills: Laurel, Mississippi

Masonite

PRESWOOD

Made by the makers of
MASONITE STRUCTURAL INSULATION

IN BUILDING BOATS



Our Readers Say—



Can't Please Everybody

I AM glad to reach the end of your articles on 'Dick Byrd—Adventurer.' I am surprised that a magazine of the authority of POPULAR SCIENCE MONTHLY should stoop to become a part of the Byrd hero-worship ballyhoo. He must have talked you into those articles just like he talks nonthinking business men to finance his hair-brained flights. He made a trip to the North Pole. For what? And who cares? Now he is going to the South Pole, so he says. Why? Oh, I know he explained it all in his last article. But the explanation doesn't satisfy intelligent people.

If you ask me, he makes these trips so that he, Byrd, can get fat profits from the pictures and articles and books and lectures afterward. Don't let him hang anything on you again and don't fall for all this aviation bunk. It will never come to anything, anyway.—L. L. C., Los Angeles, Cal.

Well, Why Not Use Boxes?

I WAS almost dumb-founded when I saw the article in your August issue telling how to build what you call 'modernistic furniture.' Of all hideous atrocities, this insane furniture is the worst. Have we become such slaves to raw efficiency that we must give up all sense of beauty and proportion? Feminine fad abolishes curves and lays on the paint. 'Modernistic furniture' follows suit. If this is 'beauty and utility,' then a freight car must be ravishing. I'd as soon furnish my home with piles of painted grocery boxes.—Veteran Homeshopper, Altoona, Pa.

"The new furniture you describe has made a hit with me. It has always been my ambition to make pieces of furniture, but always the fine work of moldings, carvings, and so on has been away beyond my modest abilities as a woodworker. The modernistic furniture is something so attractive and yet so simple that I shall delight in building it."—R. D., Peoria, Ill.

He Was on a Vacation

WHAT happened to Old Bill? Was he sick in the hospital? I missed this old fellow a lot, and I am glad to see him back again in your pages to give us more of his valuable shop advice."—S. E. N., Bridgeport, Conn.



Who Can Use These Autos?



THERE'S a fortune coming to the man who can discover a way to dispose of wrecked and discarded automobiles. Last year more than 2,000,000 autos were junked in the United States. The New York Street Cleaning Department confessed the other day that it was at a loss to get rid of the ugly wrecks left along the roadsides. Junk dealers won't even take them as gifts, saying that the metal in most of them is not worth salvaging. Street cleaners can't sweep them up and throw them into an ash truck. Mr. Bautz, the secretary of the department, said: 'You can get rid of every-

thing from broken bottles to worn-out brooms, but a junk man laughs when offered a car.'

"I happen to know that other large cities are facing the same problem, and I would like to see some inventor solve it. Yours for cleaning the scrap heaps from roads and countrysides."—S. K., New York City.

A Plea for the Apes

I HAVE just finished reading 'City of Apes for Test' in your magazine and have been stirred to the deep. The knowledge that defenseless and innocent denizens of the jungle are about to be subjected to the atrocities of man leaves me flat. I want you to inform the authority in charge of the apes to be good to the apes and the reward will be worth while. It is just a matter of survival of the fittest."—J. M., Riverhurst, Saskatchewan, Can.

They'd Fly a Good Race

I WAS much interested in your article on the speed of birds, but I have heard that bats can go as fast as swallows. Why don't you look into this?"—D. M. M., Detroit.

Every Suggestion Helps

I QUITE agree that in stories such as 'The Movie Maker,' the mechanical part is all right, but the love is the bunk. Please put in more aviation and unusual facts and ideas."—J. W., The Pas, Manitoba, Can.

"In your chemistry column, directions for making pieces of useful apparatus would not be amiss now and then."—L. G., Milford, Mass.

"I have been a reader of your magazine for years and do not know of any part that I would like changed. I hope you will always keep Herbert Paus as cover designer."—C. L. H., Vernon, Tex.

"I like to read of different ideas in the Workshop pages. The more of them the better I like it."—H. S., Sheboygan Falls, Wis.

C. F. B. is in for It

I HAVE just read what C. F. B. has to say about your article on Galileo and falling bodies. He calls the writer of this article a 'boob,' and calls all scientists ignorant. But as a matter of fact it is he who is the ignorant one. It is true that a ball of lead will travel through space faster than a wooden ball; but, C. F. B., do you know why? Because the air currents take the wooden ball. Just try the same thing with two lead balls and watch the result; and next time don't be so hasty in calling scientists fools."—D. L., Hackensack, N. J.

"C. F. B. evidently knows very little about physics. Not only will a ball of lead fall at equal rate of speed with that of a ball of wood, but a feather will do likewise (in a vacuum). This can be demonstrated in any high school laboratory."—M. H. B., Salisbury, N. C.

Why Dollars Die Young?

IT MAY be true, as you say in the August issue, that the American dollar is growing bigger. No one can well question official figures, which show that the dollar's buying power 'is thirteen cents greater than it was in 1920.'

"But why, then, doesn't the dollar last as long as it did eight years ago? I don't know

what the statistical experts say about it, but the answer seems plain to me. Nowadays we spend money for a lot of necessities which used to be luxuries. More and more inventions have made people comfortable and happy—but they certainly have made the old dollar look sick."—N. N., New Brunswick, N. J.

A Record Challenged

IN YOUR August issue, you speak of the 'Flying Scotsman' as 'the English locomotive that recently made a world's record nonstop run—between London and Edinburgh, nearly 400 miles.' If my memory is right, this was not a world's record, though it has been generally claimed. The record was made away back in 1876 by a Pennsylvania Railroad train with a nonstop run of 448 miles, and it has never been broken."—J. A. L., Pittsburgh.

To settle the matter, we referred this letter to the Pennsylvania Railroad, and received the following reply:

"Our Motive Power Department advises that the nonstop run on the Pennsylvania



Railroad in 1876, to which your reader refers, was that of the 'Jarrett and Palmer Special,' which was operated from New York to San Francisco, June 1st to 4th of that year. The run over our company's lines from New York to Pittsburgh, covering a distance of 438.5 miles, was made on June 1st without a stop, and occupied 10 hours and 18 minutes. This has always been recognized as the world's record nonstop run. It is important, however, to note that it was a special run, while the trip of the *Flying Scotsman*, of course, is made regularly daily, so that they are not exactly comparable."

Help! Give Him Air!

THE other day I got my hair cut and the barber, after using the clippers on the back of my neck, blew away the shorn hair with a garlic-laden breath. Can't some of your readers invent a simple compressed air attachment for the clippers which will enable me to get my hair cut in comfort?"—W. A. M., New York City.



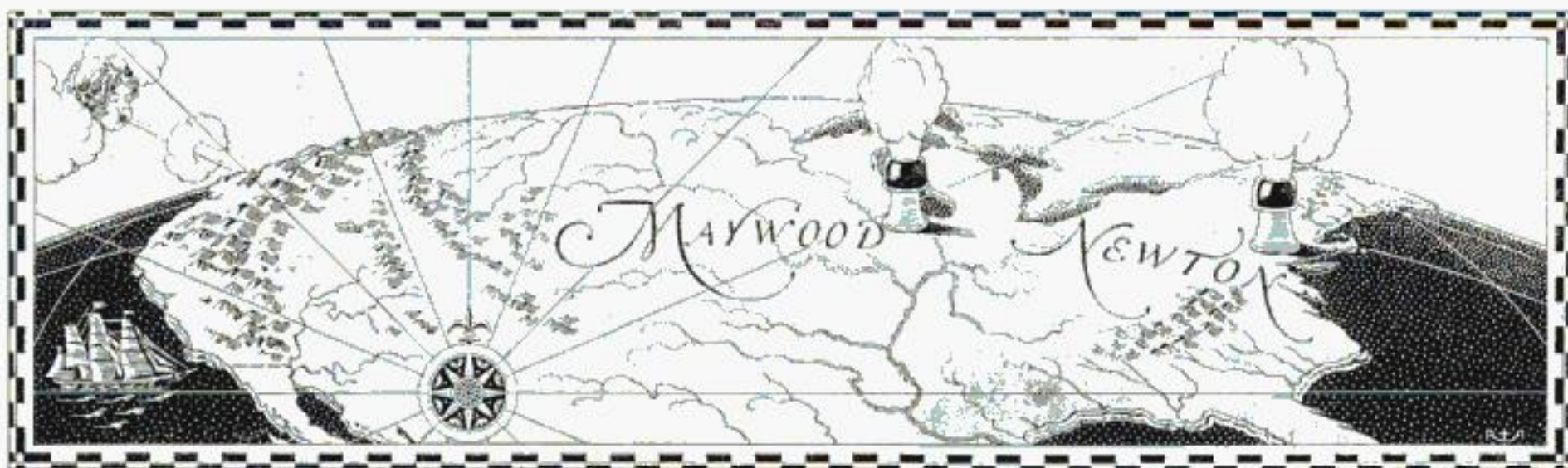
Yes, It Would

IF A shaft were drilled straight through the earth, if such a thing were possible, and something were dropped into it, would it stop midway between?"—W. T. L., Fort Calhoun, Neb.



We Blush with Pride

I HAVE the electric set and power amplifier working. It is the best radio I have ever heard. Thanks for your advice in constructing it."—A. C. K., West Haven, Conn.



In Maywood, Ill.

—Hard Water

In Newton, Mass.

—Soft Water

IN MAYWOOD, ILLINOIS, the water is 350 hard. You should lather longer if you are in a hard water region to help your Gillette Blade to do its usual smooth, sure job.

NEWTON, MASSACHUSETTS, is a paradise for men with tough beards. The hardness of the water there is only 26; your shaving brush foams up quickly; your beard is quickly softened and your Gillette Blade slides smooth as velvet over your face.

Gillette Blades shave smoothly, gently, surely—in 48 states!

YOU know how hard it is to lather with water in Maywood, near Chicago. How easy it is in the soft water of Newton, Massachusetts.

The Gillette Blade never gets the same shaving job twice, even on the same face. Water, weather, nerves, and sleep and soap all set up special shaving *conditions* for your next shave.

Perhaps you can control them all. Perhaps not. One thing you can count on—that when your face is ready, the Gillette Blade will slide along easily, cleanly, swiftly, and leave your face refreshed, natural, comfortable.

Gillette puts this dependable "face value" into every blade. Almost half of all Gillette people are skillful inspectors, paid double when they find a single blade that may not do the superb job. And even these people are paid to find mistakes in instruments adjusted to hone and strop to one ten-thousandth of an inch.

The job that a Gillette Blade must do is to make an easy, comfortable shave. Whether you hurry or loaf, lather or slap—whether the water is soft or hard, the Gillette Blade must do *its part well* for every Gillette user. That means eight men out of ten from Maine to San Diego.

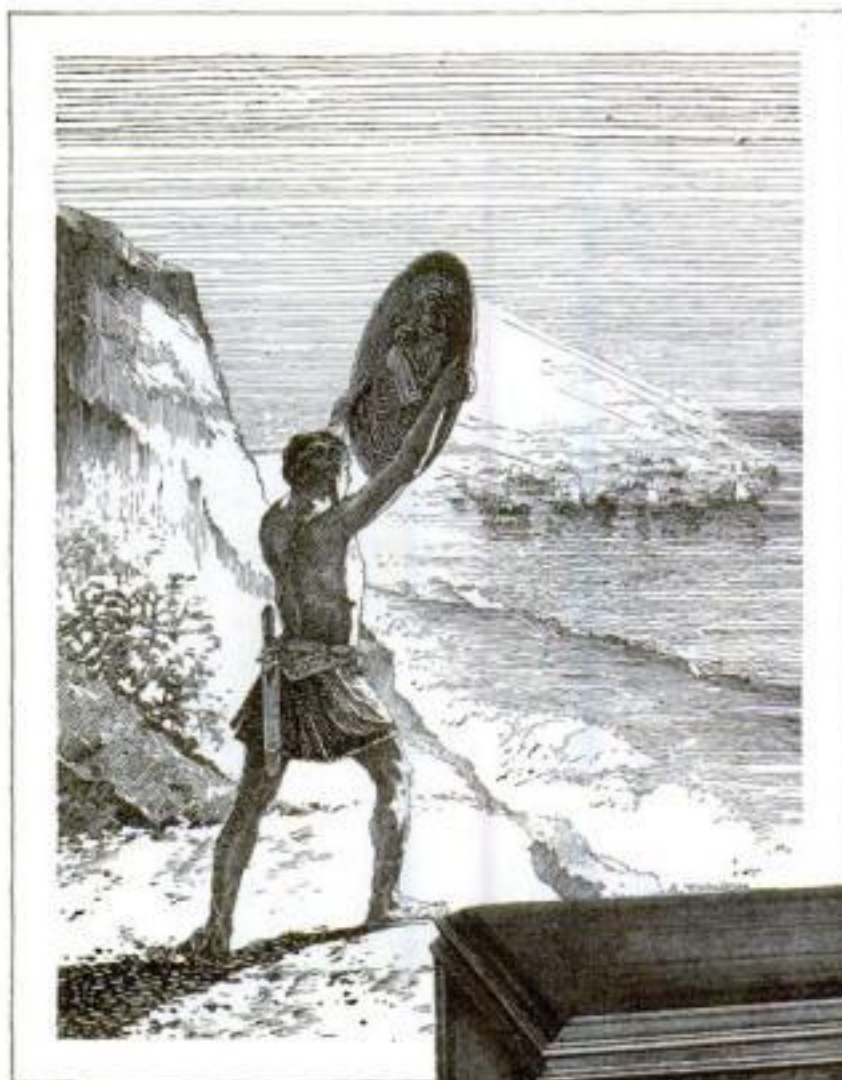
GILLETTE SAFETY RAZOR CO., BOSTON, U. S. A.



To be sure of a smooth, comfortable shave under *any* conditions, slip a fresh Gillette Blade in your razor.

Gillette





Sun-rays flashing from a shield held aloft by a traitor on Mt. Pentelcus was, in 490 B. C., the pre-arranged signal by which the Persian fleet was to be notified of the absence of the Athenian army. Miltiades, the Athenian general, saw the signal, suspected its meaning, and marched his troops from Marathon in time to successfully defend the city.

Get it Better with a Grebe



Watchfulness has ever been a wise policy, especially for those of today who through nineteen years have *watched* the Grebe contributions to the development of radio, and *waited* for the crowning achievement of the Grebe organization of radio engineers — the Grebe Synchrophase A-C Six.

They have thus assured themselves of far more than the convenience of alternating current, light-socket operation, with its relief from bother with batteries. They have, in addition, obtained inimitable Grebe tonal beauty—incomparable range and selectivity



—freedom from A-C hum—maximum volume without distortion and other distinct improvements resulting from years of experience and the careful craftsmanship of a staff of radio engineers who could not produce anything but the best. It's merely a matter of discretion to hear the Grebe Synchrophase A-C Six before making your final decision. Or send for Booklet P, which fully describes this new receiver.

Other Grebe sets and equipment: Grebe Synchrophase Seven A-C, Grebe Synchrophase Five, Grebe Natural Speaker (Illustrated), Grebe No. 1750 Speaker.

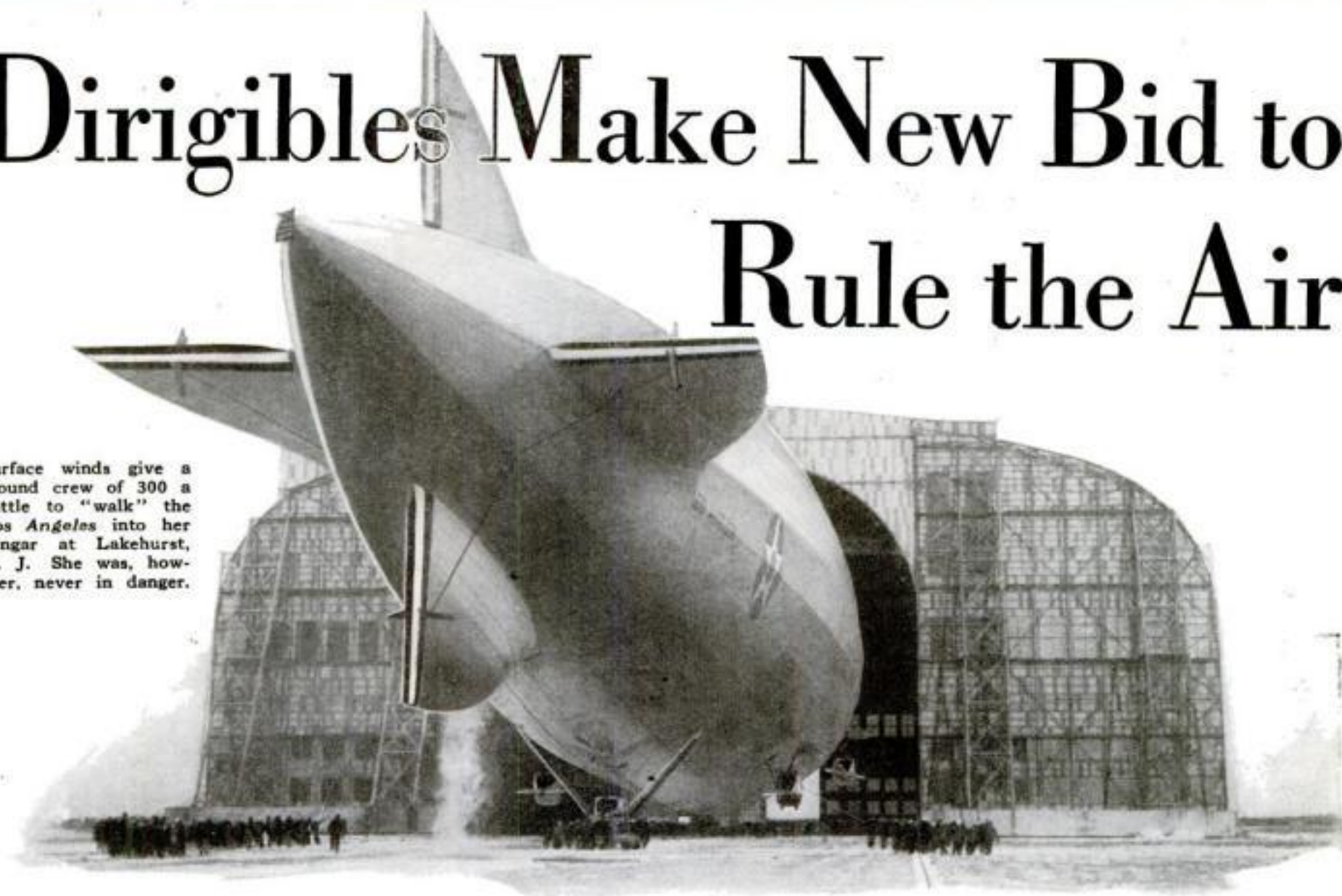
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Dirigibles Make New Bid to Rule the Air

Surface winds give a ground crew of 300 a battle to "walk" the *Los Angeles* into her hangar at Lakehurst, N. J. She was, however, never in danger.



Supremacy of Planes Challenged as Europe Prepares Flying Liners for Trans-Atlantic Service, and U. S. Navy Lays Plans for Two Huge Lighter-than-Air Ships

By H. C. DAVIS

THE destruction in the Arctic of General Nobile's comparatively small semirigid dirigible balloon the *Italia* emphasizes the fact that there is in the world today only one great Zeppelin-type dirigible in commission. That is the silvery veteran *Los Angeles*, built for us by Germany as our trophy of the war. For the moment, the United States dominates this field of aviation; yet this is the year in which newly built lighter-than-air craft are most likely to demonstrate that they, even more than airplanes, are destined to carry mankind into a new phase of traveling habits.

British-built and German-built aerial liners have been rushed toward completion in a race to win for gigantic dirigibles that attention which Lindbergh won last

year for winged craft. Lindbergh's flight was first page news: the transocean flights of this year's dirigibles will be news for the financial pages as well. Capital now invested in luxurious ocean steamships is about to witness events which may eventually make these investments all but obsolete. Even as this is written, the U. S. Navy is arranging contracts for the construction of two enormous dirigibles, of 6,000,000 cubic feet capacity each, at a cost of some \$8,000,000.

It is an old struggle, this between lighter-than-air and heavier-than-air craft. Which will be most valuable to man? Who is going to answer? Scientists? Manufacturers? Adventurers? Theorists? None of them; but bookkeepers. For the question has resolved itself into that uncompromising unit of transportation au-

ditors, the ton-mile cost. After due allowance for speed, which type of aircraft will carry a ton of freight a mile for the least amount of money?

More than half the energy expended by an airplane is employed solely to keep the machine in the air. An airship, on the other hand, spends none of its power lifting itself or its load. This vital difference is cited by adherents of lighter-than-air machines as the chief reason why dirigible balloons will win the favor of capital for large scale aerial transportation.

MOREOVER, surprising as it may seem, every increase in the size of airships increases also their operating efficiency; that is, less horsepower is required for each passenger. In airplanes, on the other hand, increase in size de-

creases relative efficiency. The freight load that an airplane can sustain in proportion to its weight is less as the size of the plane increases. By way of comparison, the huge three-motored planes which operate between London and Paris require sixty horsepower to each passenger at full load. Yet the new English airship *R-100*, scheduled to fly to New York late this fall, requires only forty-two horsepower at full load for each of its hundred passengers.

WHEN the *R-100* leaves her mooring mast fully fueled she is able to go 4,000 miles without a stop. Forty-eight hours from London to New York on a regular schedule is her plan, and the minimum fare will be \$400—to start! Later it will be less.

The Germans who have been completing the *L-127* at Friedrichshafen have been making more extravagant claims for their aerial liner, already christened *Graf Zeppelin*. This dirigible is about half again larger than our *Los Angeles*, but considerably smaller than the new British airship and little more than half as large as the U. S. Navy's projected dirigibles. Her claim to superiority is that she can fly without stop for 7,200 miles, or farther than from Berlin to San Francisco. This long-distance cruising ability has been obtained at the expense of passenger carrying capacity. Even more significant is the improved quality of the duralumin in the girders that form her rigid frame. These have been given a strength twenty percent greater than the metal in the hull of the *Los Angeles*; an improvement accomplished at a sacrifice in lightness, for the new alloy is heavier as well as stronger. In short, the *Graf Zeppelin* really is a reincarnation of the best features of all the 126 dirigibles built at Friedrichshafen since 1900, when the first Zeppelin rose in the air. Of these, only the *Los Angeles* survives; but each of the 125 that have been destroyed is memorialized in the latest one by changes of design whose value was learned by disaster and experiences less bitter.

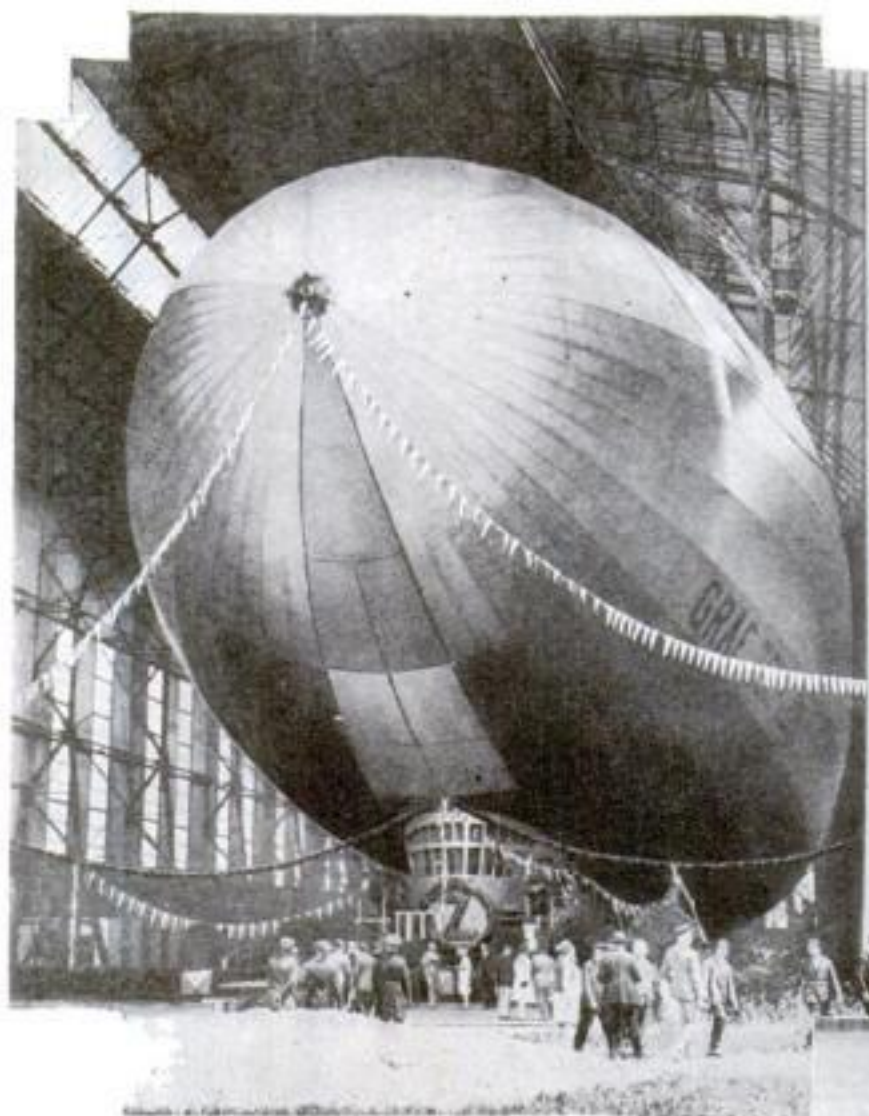
THERE are men who can read but one sign in the catastrophes of the Zeppelins—that lighter-than-air ships have no important future. Yet half an hour's conversation with the Zeppelin chief, Dr. Hugo Eckener, should be enough to convert the most dogmatic opponent of such vessels. Dr. Eckener, who brought the *Los Angeles* from Germany to Lakehurst, would tell any skeptic that if only 126 airplanes had been built since 1900, there probably would not have been any plane that could have served Colonel Lindbergh on his flight last year.

Last of the dirigibles to be destroyed was Nobile's *Italia*. But in recalling that recent tragedy, it is well to remember also that the *Italia* was a sister ship of the *Norge* in which Nobile, Amundsen, and Lincoln Ellsworth successfully crossed the Pole

from Spitzbergen to Alaska in 1926. After that memorable voyage, the *Norge* was deflated and packed for shipment home. Though the *Italia* went to her doom, the *Norge* made a perfect score.

It seems certain that the *Italia* was wrecked when she lost her buoyancy due to an accumulation of ice on the top of her semirigid bag and dragged her gondolas on the jagged ice below. When the gondolas were torn free the *Italia* shot skyward out of control. Nobile has expressed the belief that her hydrogen gas was ignited soon afterwards, causing her complete destruction. Ice, then, is one treach-

How passengers will board the *R-100*, big as the *Mauretania*, over a gangplank from the mooring mast.

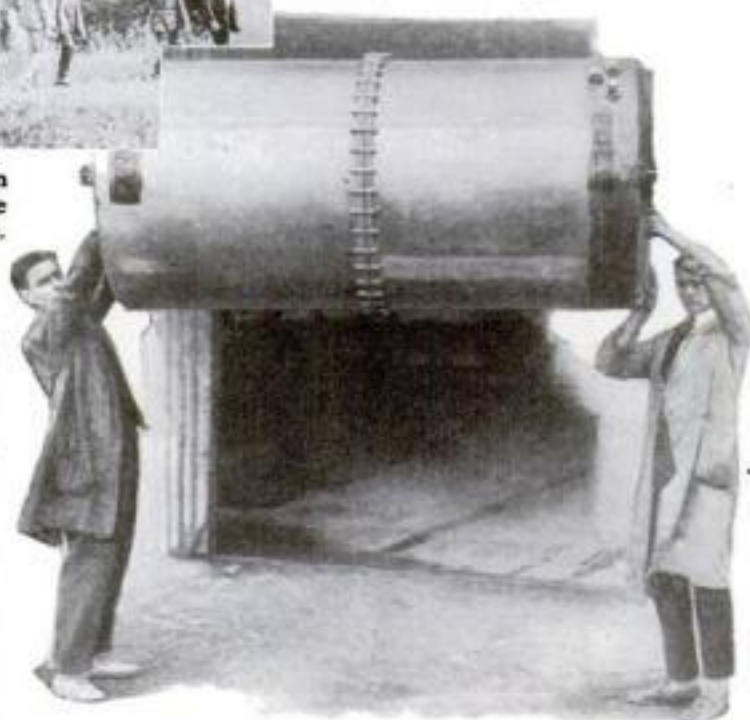


The *Graf Zeppelin* being christened in her German hangar. The 127th Zeppelin, she is called the best. She is half again larger than the *Los Angeles*.

erous enemy of dirigibles, but who believes that ingenuity will be long in conquering it? The *Italia* is simply another expensive lesson in the textbook of experience.

Not all of the lost dirigibles were victims of dangers peculiar to this type of aircraft. Some were shot down by French and British guns. Some were deliberately destroyed after the war by their German custodians to prevent their being surrendered under the Treaty of Versailles. Even so, the final adventures of the ill-fated dirigibles give a fairly complete record of menaces which airship navigators must guard against.

In 1915, the German Zeppelin *L-10* was struck by lightning and crashed in flames. This lurid fate has overtaken others, but now that the cause has been studied, probably never again will such a



One of the 275-gallon petrol tanks of the British dirigible *R-100*, so light they can be lifted with one hand. The ship is scheduled to visit the United States soon.

tragedy occur. The *L-10* almost certainly took fire because the bolt struck when some of her sustaining hydrogen gas, highly inflammable, was being valved. Naturally it ignited. Other dirigibles have been struck by lightning and survived. Our *Los Angeles*, when inflated with helium, is in little danger from lightning or other fire menaces. Helium will not burn.

IN 1919 the British-built dirigible *NS-11* ran into a storm over the North Sea, was struck by lightning, and fell in flames. But she was a nonrigid, made purely for war service only, and lacked a metallic skeleton.

With fifty Frenchmen aboard, the *Dixmude*, surrendered by the Germans to France, was lost in the Mediterranean in 1923, and the cause remains a mystery. The answer probably is that most of the crew lacked the specialized knowledge required to sail the ship.

The loss of America's *Shenandoah*, the *Dixmude*, and the several British dirigibles would be attributed by any German officer of the old Zeppelin fleet to the same

lack of experience. When Americans and the British shall have built and handled big dirigibles for twenty-five years the experience factor will not be a problem.

Americans, probably, were more impressed with the wreck of the Navy's American built dirigible *Shenandoah* in 1925 than by all the other accidents to dirigibles. Critics have contended that she was too slender, that her ratio of fineness was too great, so the twisting winds over Ohio broke her in two.

COMMANDER Zachary Lansdowne and thirteen of the crew were lost, but as evidence that the wreck of a dirigible does not mean the loss of all hands there is Commander C. E. Rosendahl, now in Germany awaiting the flight of the new German ship, who came to earth on a part of the wreckage—the bow half—that floated down out of control, but still possessed of buoyancy. And with him twenty-

The huge *Los Angeles* and two dirigible escorts.

For forced landings at sea a Zeppelin can be equipped with landing floats, which greatly reduce danger of death. See how easily this dirigible is landing.

five others survived. The *Shenandoah* cost the United States \$2,950,000 to build, and before she cracked up had cruised more than 30,000 miles. Her fate offered a lesson that needed to be learned but once. Hereafter our dirigibles will avoid regions and seasons of cyclonic and other twisting windstorms.

Only when resisting an ordinary wind-storm is a dirigible in danger. Many a dirigible has beaten a storm by riding it. Once the *Shenandoah* was torn from her mooring mast at Lakehurst, N. J., and was swept away to what an anxious country thought would be her destruction. Instead, she rode that storm as gently as a feather, and throughout a long night her radio operator gave amateur wireless operators the details of what

had become a mild adventure. The *Shenandoah* was out of trouble the instant her nose was torn, setting her free in that element where she was most at home; but what she rode, of course, was a gale and not a twister.

The small dirigible of the future may be able to ride on the rim of a cyclone, but the *Shenandoah* was not built to withstand such a strain.

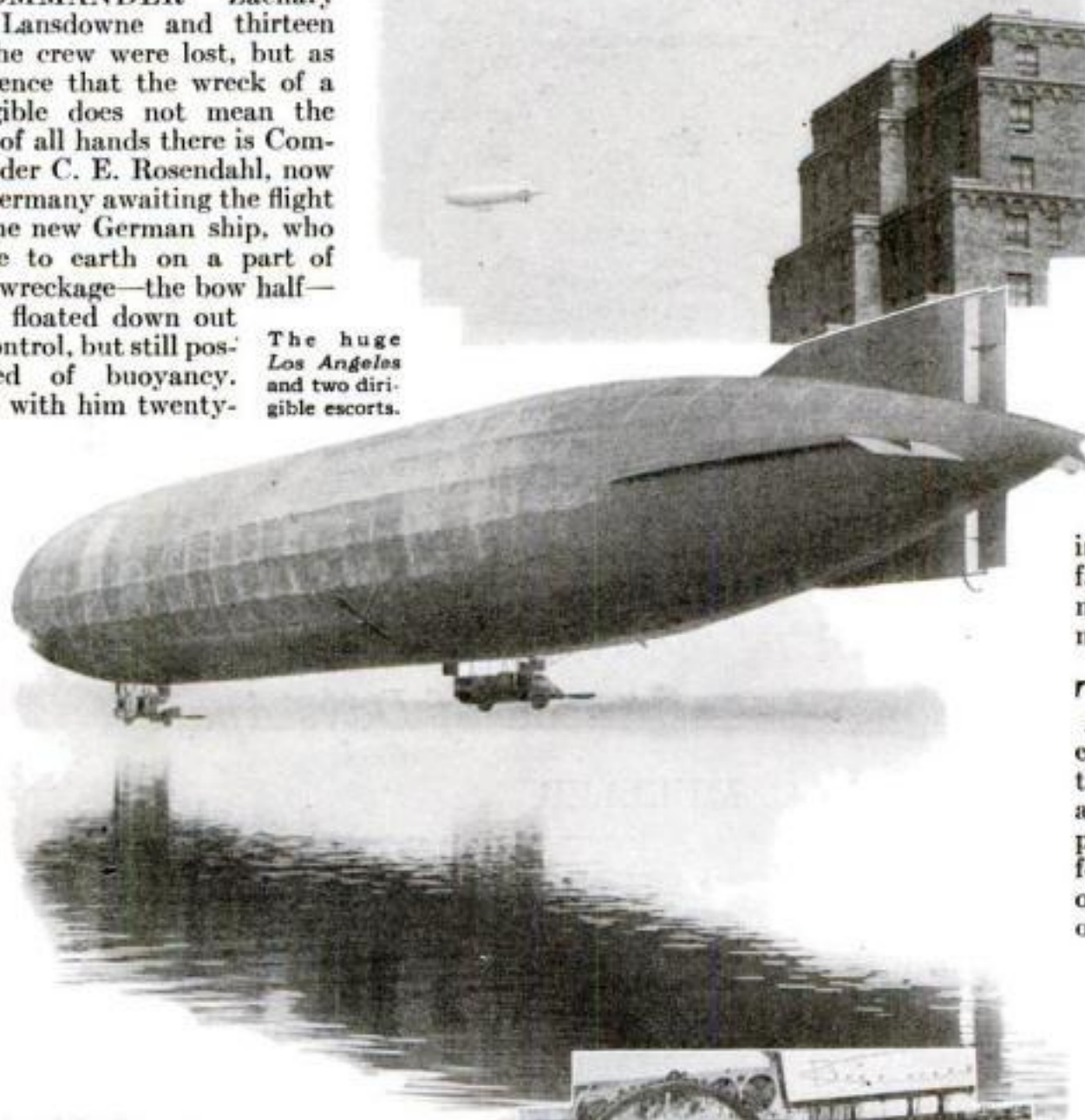
In the same year that the *Shenandoah* was destroyed the British *R-33* was torn from her mooring mast at Pulham, England, and for thirty hours rode safely on a storm that carried her to Holland with less discomfort for her crew than would be suffered by Gloucester fishermen in a blow on the Grand Banks.

The *R-33* was much like the *R-34* in which a crew of British sailors flew from Scotland to Mineola, N. Y., in July, 1919, and then returned. We are too apt to forget the magnificent accomplishment of that round trip over the Atlantic, and remember instead the appalling wreck of the *ZR-2*, another British dirigible, German-built. She was on a trial flight over the Humber River, near London, with a crew that included seventeen Americans and forty-nine British, when

she burst into flames. Apparently her hydrogen was ignited. The *ZR-2* was to have been purchased by the United States for \$2,000,000. Her cruising radius was estimated at 9,000 miles, farther than from San Francisco to Manila. The airplane for such distance has not been devised.

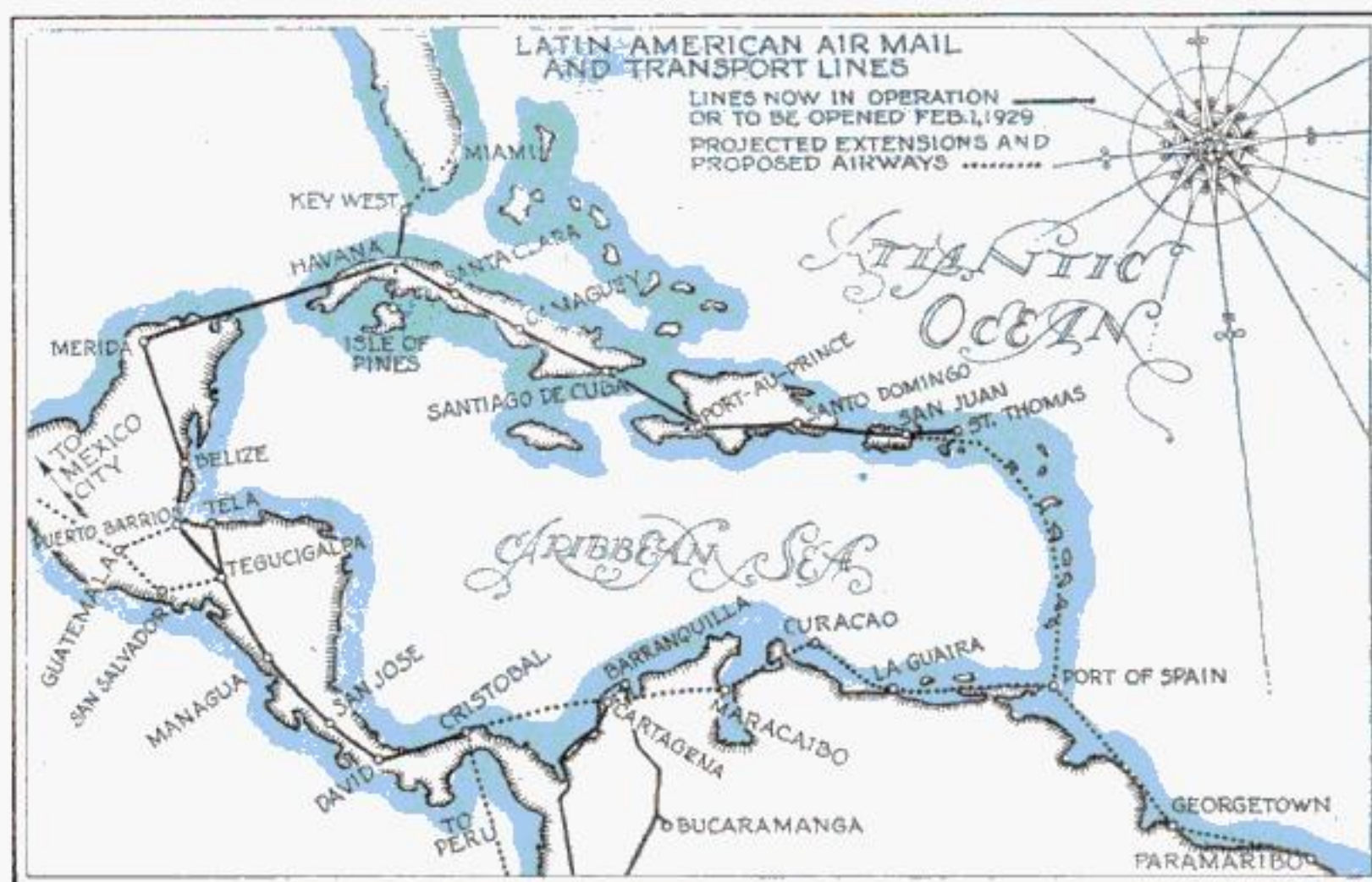
THUS far, the airplane has had all the advantage of far wider experience and experiment than has the dirigible, although when the European war broke out airship development was far ahead of airplane development. The military need for speed in observation poured a flood of money into the fabrication of swarms of airplanes. Armies of pilots were trained, and the sum of their experiences was woven into the fabric of wings. Dr. Eckener would tell adherents of airplanes that ninety-five percent of all the money spent on aviation has gone for airplanes; and hundreds of planes can be fabricated for the price of a single great dirigible. This means that every single experiment in dirigible balloons has been overmatched by thousands of experiments in airplanes. In spite of this disproportion the dirigible has demonstrated that it can serve men in a way that is not possible for heavier-than-aircraft.

In the *Graf Zeppelin* we have the 127th generation in the line of air giants. And when she leaves the ground she will swim in her natural element with propelling power that is as much of an innovation as was the steam that drove Robert Fulton's first steamboat. This new fuel is etan—a form of hydrogen gas having the weight of air, so that as it is expended there is no longer any necessity for valving away the precious sustaining gases contained in the envelope of the airship. Heretofore, as an airship's engines have consumed gasoline, it has been necessary to compensate *(Continued on page 150)*



Chief Boatswains Mate C. C. Dean in the *Los Angeles* operating the elevator wheel which, by moving the horizontal rudders, govern altitude.

New Air Lines Link All Americas



How aviation brings Latin America within commuting distance of America. A man in Port-au-Prince, five days from New York by boat, will receive a letter the day after it is mailed in the metropolis.

Stupendous Project, Equal to the Greatest in Europe, Will Make the Continents Hours Instead of Days Apart

By GROVER C. MUELLER

NOW Central America and the West Indies are to be linked to the United States by air. Contracts for carrying U. S. air mail to Haiti, Santo Domingo, and Porto Rico over one new route and to Mexico, Central America, and Panama over another have just been awarded to Pan-American Airways, present operator of a Key West-Havana airline, and this company's fourteen-passenger monoplanes, largest ever built by the Fokker Company, will shortly inaugurate mail and passenger service.

The stupendous project dwarfs present American air lines. By 1929 it will be the equal of any great European system such as the French Latécoere Company that serves Europe, Africa, and South America.

American and Latin American business interests will be the first gainers. A concern in Port-au-Prince, Haiti, almost the geographical center of the West Indies, will receive a New York letter the day after it is mailed, answering it by return plane with similar speed. By steamer this would take five days each way. The system affords 100-mile-an-hour service to tourists and pleasure seekers. Cuba, Haiti, and Porto Rico, with their popular resorts, are brought within commuting distance of the United States. Colon, Panama, five days out of New Orleans

and seven from New York by boat, is but two and a half days from Miami and three from New York by air. Central and South American cities, some of them three weeks away by steamer or train, are brought within a few days' journey at most. Lastly, an intensely interesting feature of the new lines is the possibility of a complete air hook-up between North and South America, following the stimulus it must inevitably give to South American aviation.

By the first of January, the Pan-American Airways will commence service via Havana to Mexico, Honduras, Nicaragua, Costa Rica, Panama, and the Canal Zone. Its other route, open by February first, covers all of Cuba, Haiti, Santo Domingo, and Porto Rico—these points also being on the air passenger line of the West Indian Aerial Express.

At the Government's option, both new lines may be extended—the Panama route through South America to Paramaribo, Dutch Guiana; and the Porto Rico route joining it after crossing the Caribbean, at Trinidad, thus completing the "Lindbergh circle" traced by Col. Lindbergh in his Pan-American flight.

Also under consideration is the possibility of the establishment of a large airport at Port-au-Prince, Haiti, from which planes could work in conjunction with

steamships. It is pointed out that Haiti is now under an American protectorate and that from Port-au-Prince it is possible to reach points on the mainland of the United States, Central America, Panama, and on the north coast of South America with overwater flights of less than 500 miles.

Already plans are under way to tie in South America with the new system. On the west coast, an American concern has obtained a franchise for a Peru-U. S. air route, presumably connecting Lima, Peru, and Cristobal, C. Z. Thence southward, air travel is sufficiently practical to add significance to Postmaster-General New's recent statement, "I hope to see the air mail route opened from Boston to Valparaiso, Chile, before I leave my present post in March, 1929." And a few hundred miles beyond the end of Pan-American Airways' extension to Guiana, an existing French airline skirts the eastern coast from Brazil down to Buenos Aires, Argentina. This gap may now be closed.

Another important link in South America's airway system, the Scadta German line whose hydroplanes today supplant tedious river travel in Colombia, will connect directly with the proposed Colon-South America extension, as will other local airlines.



George Eastman (left), 74-year-old inventor of photographic apparatus, points out to Thomas A. Edison (center) and General Pershing the simplicity of the color movie camera.

Secrets of New Color Movies

Twenty-five Years of Experiment at Last
Make Home Screen Pictures in Natural
Hues a Simple Process for Everyone

By ROBERT E. MARTIN

EPOCH making inventions usually turn out to be astonishingly simple. All the revolutionary developments of radio, for example, hinge on the discovery of what takes place when three simple pieces of metal are inclosed in a glass bulb and the air is pumped out.

And now that the dream of moving pictures in full color at last has been satisfactorily solved we find that it, too, seems almost childishly simple. A plain color screen divided into red, green, and blue sections is placed in front of the lens of the home movie camera, a cylindrically corrugated surface is produced on ordinary film, and, presto! the thing is done!

Baby's face that used to appear on the screen as a shade of pasty gray looms up by the new process in a natural, rosy flesh color. His red lips are red and not just black streaks. Beautifully colored flowers have all the vivid hues on the screen that they had when you focused your movie camera on them in the field.

But, simple though it is, this realization of the dream of George Eastman, 74-year-old inventor of cameras and photographic apparatus, recently became an actuality only after years of work by research engineers and the expenditure of vast sums of money.

When the first really successful home movies in natural colors were shown to the public, the other day, on a screen in Mr. Eastman's home at

AN ARTICLE in our last month's issue told how talking pictures are making over the movies. Here Mr. Martin describes another revolution—home movies in natural colors. For the first time he gives a simple, understandable explanation of the ingenious process perfected after a quarter of a century of experiment.



Edison in the movies. George Eastman takes a "shot" at his veteran comrade in invention with a small home movie camera.

Rochester, N. Y., it was revealed that they were the product of ten years of dogged experiment by John G. Capstaff, a 48-year-old photographic expert in the Eastman Kodak Company Laboratory. As chief assistant to Dr. C. E. Kenneth Mees, director of the Laboratory, it was he also who developed amateur motion pictures in black and white to their present stage of perfection.

Final success in color movies, Mr. Capstaff said, resulted from "knowledge, experience and trying. It was just a case of trying and trying until we finally found the thing we were after. We would work out some ideas successfully and then find ourselves stumped by something else. At least half a dozen times we came to the conclusion that the thing was absolutely impossible. Sometimes we were about to give it up when something else developed and we tackled it again."

AND yet in its solution the process is such that anyone, grownups and children alike, can take color movies and project them in the living room with little more difficulty than operating an ordinary camera, and with little more expense than in making black and white home movies.

Assuming that you already own a standard type of home movie camera fitted with an F 1.9 lens and you have one of the better grade of projectors, all you will need in addition are comparatively inexpensive

color screens for your camera and projector, and the special film that projects in full color.

The special color screens slip on and off the camera and projector like the cover on a pill box. No tools are needed.

You don't have to know anything about color photography to get good results. In fact, the process of taking the pictures and projecting them is the same as when ordinary film is used. The only point you have to remember is that movies in color can be taken only in bright sunlight. If you try to take them on cloudy days or in poor light, the result will be failure. This is because the color screen cuts down the effect of the light on the film. And this decrease in light also explains why it is necessary to use an F 1.9 lens. The fast lens is needed to make up for the use of the color screen. Consequently you cannot take movies in color with the slower lenses, ranging in speed from F 3.5 down.

WHEN Mr. Eastman, twenty-five years ago, set out to develop color movies for the amateur photographer, every proposed scheme that showed the least possibility had to be investigated.

Photography in color, that is, still pictures taken with an ordinary camera, has been achieved by a number of different processes, the most successful of which undoubtedly has been Lumiere's Autochrome process, introduced in 1907. In this process a layer of red, green, and blue starch grains were placed on the plate under the sensitive emulsion and the plate was exposed with the glass back toward the lens. Thus, the image was passed through the colored starch grains and each grain allowed the light to register only in proportion to the amount of that particular color there was in the ray. After development and reversal, the plates were transparencies in full color.

In 1908 G. A. Smith and C. Urban introduced a system for taking and projecting colored moving pictures which consisted, essentially, of a way of speeding up the taking and projection from sixteen pictures a second, the normal speed, to thirty a second. Every other picture was taken and projected through an orange-red glass and the alternate ones through a blue-green glass. This system had disadvantages which were never overcome. One of the chief of these was that while an object such as a human arm was reproduced with a color closely approximating true flesh while the arm remained stationary, if the arm moved rapidly it appeared on the screen as a series of vivid red and green flashes.

OF COURSE, many other methods have been proposed for making both still and motion picture photographs in color. Many looked good theoretically, but could not be realized practically.

The final success is an interesting development of a process invented in France and covered by patents in the United States as well as in many foreign countries. The original working out of the patented idea was, however, so com-



Dr. C. E. K. Mees, director of the Eastman Research Laboratory, examines the color filter of the new camera developed under his supervision. Top: How the color filter fits over the camera lens. Left: A strip of the color film.

plicated and impractical that it had not been a commercial success.

As everyone knows, a motion picture is merely a succession of still pictures projected on the screen one after the other so rapidly that the human eye is deceived and the illusion of motion is created.

The new Eastman color process is mechanically simple to understand if you have an elementary knowledge of the

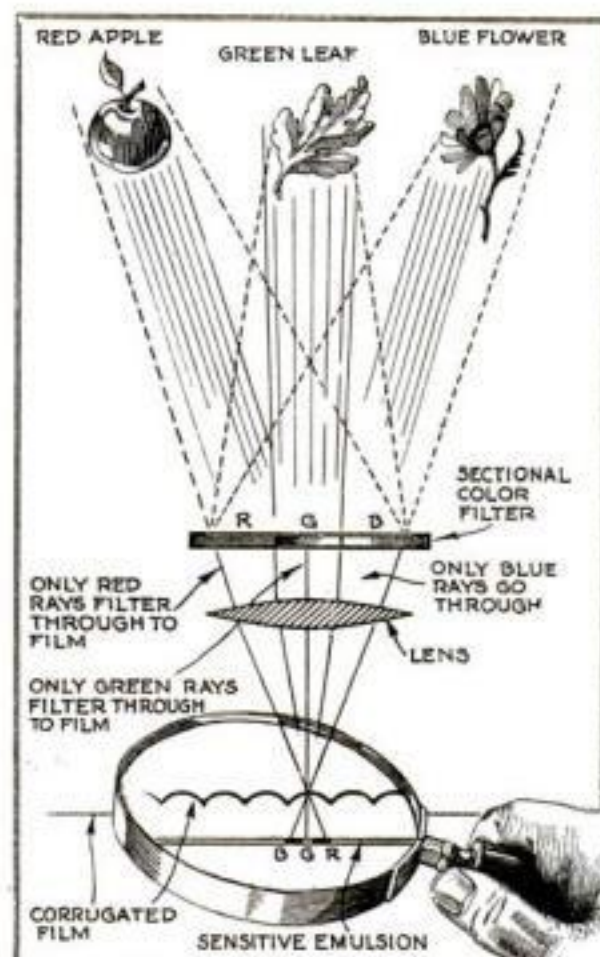


Diagram showing the new process of registering color images with corrugated film, as explained in this article.

action of a lens in producing an image on a plate or a section of motion picture film.

Without going into the technicalities of the high speed anastigmat lens, you can get a pretty good idea of the general action of a lens and the basic principle of movies in color by a few simple experiments with an ordinary magnifying glass, which is a simple form of lens. If you hold this lens between a piece of paper and the window and move it back and forth, you will find a position for the glass where a small image of the window is produced on the white paper. If you leave the lens in that position and hold another piece of paper so that it covers up a third of the lens, the small image on the paper back of the lens will become weaker, though still complete. The paper covering part of the lens does not cut off part of the image of window; it simply reduces the amount of light that forms it. In other words, light from each point of the window is striking every point of the lens, and all these rays of light are bent by the lens so that they come together back of it to form the corresponding part of the image on the paper. Each point on the paper is, therefore, receiving light through every part of the lens.

If you should place in front of the lens a screen divided into approximately equivalent red, green, and blue sections, the image on the paper back of the screen still would appear white because the rays through the colored sections would join to form points of white light.

Similarly, if you placed a colored screen in front of the lens of your home movie camera and used ordinary film in it, you would get the usual black and white picture.

THE special film for taking colored movies differs from regular film only in that on the side opposite the sensitive emulsion which registers the picture, the surface of the celluloid is corrugated lengthwise of the strip of film with a continuous row of cylindrically shaped ribs, pressed in manufacture with a steel die. The surface is, in fact, like ordinary corrugated paper except that the ribs are truly circular in contour and there are 559 of them to the inch, each in effect a tiny lens.

The film is placed in the camera back-side foremost so that the ribbed surface faces the lens. The light therefore has to travel through these ribs to reach the sensitive layer of silver salts that records the picture.

The curvature of the surface of each rib is so calculated that the tiny lens which it forms is focused on the lens of the camera. This means that if the camera were held up to the light and you looked at the film with a powerful magnifying glass you would see an image of the lens under each rib on the film. If the sectional color filter were in place you would see red at one side, green in the middle, and blue at the other. Of course, a cylindrical lens only focuses in one plane, so that each (Continued on page 153)

The Colorado Spanned at Last

Engineers Ingeniously Reach Across a 500-Foot Canyon to Bridge a Tourist Highway into a Painted Wonderland

By ELLSWORTH BENNETT

WITHIN a few weeks motorists will drive over the first bridge ever flung across the canyon of the Colorado River. Looking down between the sheer walls of Marble Gorge to the turbulent stream 500 feet below, tourists in northwestern Arizona will witness a combined spectacle of scenic grandeur and engineering achievement unsurpassed anywhere.

All summer sure-footed steel workers, exiled in the gorgeous table-land beyond the Painted Desert, 135 miles from the nearest town, have crawled out over a deep and narrow gash in the earth to span the chasm with beams and girders. Din of riveting hammers has shattered a vast silence unbroken since the beginning of time.

Now the bridge nears completion. Located just above the Grand Canyon and a short distance below the famous Lee's Ferry, it will open a highway from the south into a wonderland which heretofore has been known only to adventurers.

The bridge is remarkable for the fact that the builders, to reach across the gorge, figuratively had to lift themselves by their bootstraps. They could work from one side of the canyon only—from the south. The untraveled table-land beyond the northern rim offered no means of transporting or assembling materials on that side. The single approach was from the railway at Flagstaff 135 miles to the south.

ENGINEERS solved the difficulty ingeniously. Starting with a foothold on the south wall, they constructed a projecting half arch which extended 308 feet to the middle of the canyon. Suspended precariously this half was prevented from swaying and possibly crashing to destruction by strong cables anchored in the solid rock of the wall.



This took nerve—pushing the first steel beam out from the south rim of the canyon, 500 feet above the Colorado. Left: Setting a rock anchor for supporting cables.



The first half of the arch structure nearing completion. On the projecting end, which was built out 308 feet into space to the middle of the canyon, was erected a tower from which supply cables were stretched to the inaccessible opposite rim of the canyon.

Next, to build the second half, the engineers erected a tower on the end of the projecting span and from it ran cables to the north rim, providing means of transporting workmen and materials to the opposite side. From there the north half of the arch was pushed out to meet the first. Finally, at the center, the two projecting ends were firmly interlaced, forming a single rugged span.

The perilous task demanded extraordinary skill and nerve. One slip meant almost instant death. One of the men, LaFayette McDonald, of Kansas City, lost his foothold and plunged from a beam into the swirling stream which has claimed more than one adventurous explorer and prospector.

THE completed bridge is 616 feet long. It will open to tourist travel a magnificent region in the northwest corner of Arizona and across the border into Utah. Among the scenic beauties of this lonely land are Bryce Canyon, Zion Canyon, Kaibab Forest, Cedar Breaks, and the Vermilion Cliffs. Heretofore the only means of reaching it has been by means of a primitive flat-bottom scow at the treacherous crossing of the Colorado at Lee's Ferry. In high water this crossing is extremely perilous. Only a few months ago three motor tourists lost their lives when the rude ferryboat

capsized in the swift current. With the river in flood, persons desiring to reach the country north of the canyon have had to travel nearly a thousand miles through California, Nevada, and Utah. The bridge also will make more accessible the region south of the canyon, including the Petrified Forest, Rainbow Bridge, and the Hopi villages.

Of the \$330,000 cost of the bridge, \$100,000 was appropriated from the tribal funds of the Navajo Indians, whose forefathers were the first to chart the desert trails or scale the canyon precipices.



All photographs by courtesy of Dr. H. L. Shapiro, R. H. Beck, and the American Museum of Natural History.

South Sea Colony Facts About

THE Amazing Adventures of Nine "Robinson Crusoes" and Their Native Wives on an Uninhabited South Sea Island Have Altered Age-Old Scientific Beliefs. From Their Descendants There Dr. H. L. Shapiro, Eminent Anthropologist, Has Discovered Upsetting Facts About the Results of Marriage Among Relatives

RETURNING from one of the strangest quests in modern science, Dr. H. L. Shapiro, anthropologist at the American Museum of Natural History, brought to America, not long ago, fresh facts about the mysterious laws that govern the birth and destiny of human beings.

On a tiny dot of land in the South Pacific, Pitcairn Island, he had visited the most amazing colony in the world. A century and a half ago, nine mutineers wrecked their stolen ship on this uninhabited island and, landing their native wives, set up a fantastic little kingdom, isolated from the world!

In the years that followed, their descendants, all closely related, intermarried generation after generation. Now they number nearly a thousand, and the unique register of births and marriages, carefully kept from the beginning, is the only complete record of a long time experiment in human inbreeding, or the marriage between near blood relations.

It was this document, and the children of six generations of such matings, that Dr. Shapiro journeyed



Some descendants of the *Bounty* mutineers gathering for dedication of the Methodist Church on Pitcairn Island. All of them are blood relatives.

so far to see. And his investigation has cast doubt on the belief, centuries old, that children of closely related parents are always defective.

THE story of this unique colony that is altering our understanding of the laws of heredity goes back to the night of April 28, 1778, when H.M.S. *Bounty* was plowing homeward through the phosphorescent waters of the South Seas after six months of gathering breadfruit plants in the Polynesian Islands to introduce

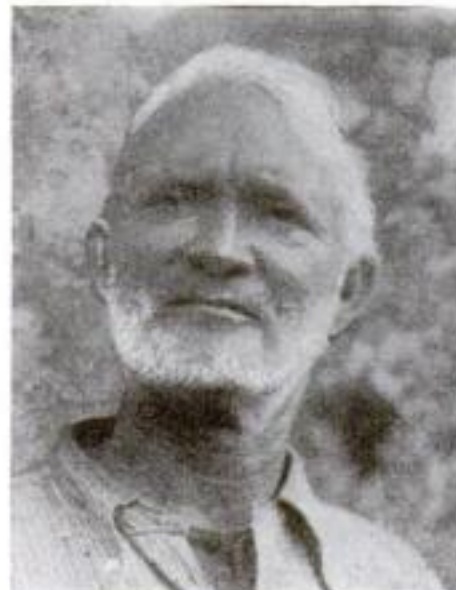
to the friendly natives of Tahiti.

Harried by fear of the vengeance they knew would try to hunt them down when the news of their crime reached England, nine of the mutineers decided upon a desperate plan. With their native wives and six native men, three of them married, they boarded the *Bounty* and with a few tools and provisions, some chickens, and a pair of goats, sailed out of the world of men forever.

Five hundred leagues south and east they sighted, in the middle of the southern Pacific, a speck of land a mile and a half long, far off the track of ships and men. Here they ran the *Bounty*

into the West Indies. After the easy life of the tropical islands, the crew had grown sullen under the discipline of Captain William Bligh, hard-fisted driver of the sea.

AS HE slept a handful of desperate men crept down the dark companionway from the afterdeck, crashed into his cabin with cutlasses and muskets, threatened his life, and seized the ship. Bligh with eighteen of the crew were cut adrift in a small boat in waters that washed only the inhospitable shores of near-by cannibal islands. Then the mutineers sailed back



These photographs, published by courtesy of Dr. H. L. Shapiro and the American Museum of Natural History, show various types of descendants in fourth and fifth generations of the *Bounty* mutineers and their Tahitian wives. All were taken on Pitcairn Island.

Reveals New Heredity

By EDWIN W. TEALE

aground, set fire to the vessel to destroy all trace, and became voluntary Robinson Crusoes on the deserted island; but, unlike Robinson Crusoe, none ever returned to civilization, even after the world found it years later. Thus began, a hundred and fifty years ago, the amazing colony that Dr. Shapiro set out to study.

For centuries an accepted law of genetics had been that close relationship in parents meant weakened and defective children, by this law the five or six generations of near kin that had been intermarrying should have become a race of defectives.

Instead, ship surgeons who stopped at the island noted the uniform brightness and health of the children. Sturdy young men could carry more than six hundred pounds and one lifted, single-handed, a twenty-eight-foot boat to his shoulders. All were described as mentally alert and morally strong.

At first little attention was paid to these mystifying reports that drifted out to the world of science. Then, about the beginning of the present century, the buried papers of Gregor Mendel, a thin-lipped Augustinian monk who had learned new facts about heredity from his pea-garden in the monastery yard at Brunn, Austria, came to light. They brought a revolution in the study of genetics and men began to challenge with new tests many of the accepted ideas of the past.

AT HARVARD University, Dr. William E. Castle, of the Zoölogy Department, began mating brother and sister fruit-flies and after fifty generations found no decrease in their size or fertility. Then, more recently, Dr. Helen Dean King, of the Wistar Institute in Philadelphia, mated white rats for nearly six years, generation after generation, with



A Pitcairn Island home of the present day. Wood construction and the tropical thatched roof suggest the European-Tahitian ancestry of the owners.



A Pitcairn picnic. "Uncle" Cornish, the bearded man, is a grandson of a mutineer.

close blood-relatives, and a high percentage of the offspring were strong and healthy.

Tests with guinea pigs by Dr. Sewall Wright, in charge of animal genetics at the U. S. Department of Agriculture's Washington, D. C., laboratory, had similar results.

More men began to question the age-old theory. Some scientists pointed to the gypsy moth which, introduced into New England in small

numbers, had spread rapidly. Its matings must have been between close relatives.

However, neither fruit-flies nor white rats nor guinea pigs are men. Only by observing an experiment with men themselves could any genetic laws, as applied to them, be determined—and to see the results of such an experiment Dr. Shapiro set forth for Pitcairn Island.

He found that this tiny, volcanic rock had been a human experimental laboratory for a century and a half, and how its record came to be written is part of the astonishing drama enacted after the blazing hull of the *Bounty* went down.

In makeshift tents of sailcloth the refugees spent a restless first night, fearing possible attack by natives hiding in the hills. But next morning search parties scouring the island found no life but that

of sea birds, a rat, and a small lizard.

Now the island was divided into nine equal parts, each white man taking one. Houses were built of bamboo poles and thatched with palm leaves. In a primitive way the settlers began cultivation of the red soil, of volcanic origin, which they found fertile. In the hills, away from the coast, a tree was discovered which they called the "cloth tree." When they pounded up the wood it yielded long, tough fibers, which they wove into a fabric not unlike linen and made into crude fish nets which replenished their supply of food.

BESIDES fish and the fruits and crops of the island, they found bird's eggs on the cliffs. On special occasions, they roasted a whole pig, Tahitian fashion, burying it in a pit and covering it over with a mat of leaves.

The recording of time was so important that the first child born was named "Thursday October," because it came on that day of the week in that month!

For a short time all went well; then came disasters and dissensions. One mutineer lost his wife, who slipped into the sea while gathering eggs on the cliffs. He demanded the wife of a native, bringing a revolt in which the natives ambushed and killed five white men before they in turn were slain.

One of the remaining men had worked in a Scotch distillery and found that from the native "ti plant" an intoxicating drink could be made. He leaped from a cliff in a drunken delirium. Two of the men left murdered the third and one died of asthma.

(Continued on page 174)

John Kenlon—Fire Fighter

The Thrilling Story of Modern Combat with Flames, as Seen by New York's Great Veteran Chief

By HENRY MORTON ROBINSON



A million dollar warehouse fire under such headway that merely to save the adjoining property would be victory.



Not from his office does Chief Kenlon direct his fire fighters. Here he is "on the job."



John Kenlon, aged 68, who has spent 50 years as a fire fighter. The story of his experiences, related here by Mr. Robinson, is the first of an interesting series, which will deal with deeds of unusual men.

FIRE in mid-ocean!

A flame-crazed bolt of lightning had just splintered the topgallant mast of the clipper ship, *Santa Anna*, reeling up the east coast of South America after a frightful passage around Cape Horn. Exhausted from her battle with icy hurricanes, the *Santa Anna* now rolled like a blazing barrel in an Antarctic thunderstorm twelve hundred miles off her course. The fatal bolt, riding down the mast and penetrating the sail-locker, had made the stores of tar and canvas a roaring bonfire, menacing ship and crew with swift extinction!

With white faces, officers and men alike gazed on the appalling sight—but their dismay was not allowed to endure. For instantly a young officer sprang forward with the crisp commands of an instinctive leader that rose above the gale:

"Starboard watch, haul out the burning gear! Pitch it overboard! Port watch, man the firebuckets! Bos'n, rig the pump! Lend a hand, men."

Before his subordinates could act the young mate leaped into the burning locker and ran with a flaming sheet of canvas to the side of the ship. His hands seared and bleeding, he went back for more again and again, and the crew, spurred by his example, followed until the last blazing sheet had been hurled into the mountainous sea . . .

THIS was John Kenlon's answer, at the age of twenty, to the most perilous challenge a sailor can meet. Choke it with your bare hands! And today that same fire-killing instinct makes him Chief of the New York Fire Department, one of the most picturesque and efficient fire fighters in the world.

John Kenlon moves and speaks like a man who has spent his life in danger. Skippers of transatlantic liners, engineers

of crack locomotives have much the same cool bearing that John Kenlon displays in ordering his men out of a doomed building or directing a million gallons of water a minute at a skyscraper volcano. You feel that this man has met and conquered all the hazards of fire and flood. And he has. He has reefed sails in Antarctic twisters, climbed to a hundred deaths up willowy masts and wind-shaken extension ladders, clung to bucking helms and hose lines while face and hands were caked with icy spray.

DANGER is his "dish" and at sixty-eight, after nearly fifty years of fire-fighting, he is still hungry for more. At a recent warehouse fire, a 3-inch hose line broke from two firemen and like a maddened boa-constrictor flailed wildly about, knocking down a dozen men who tried to capture it. Kenlon flung himself at the berserker nozzle, seized it in both hands, and forced it to submission. The next day, two very humble firemen were down at headquarters taking a lesson in line handling from a white-haired man.

A departmental tradition that John Kenlon is at his best in an emergency arose from his repeated feats of daring in the old "quick-burner" tenement-house fires, where hair-trigger thought and action were necessary. Once at a vicious tenement fire the extension ladders could not quite reach the roof of a pent-house where a mother and her three children had fled. It was the worst possible place for them to go, and speedy cremation seemed to be their only fate. Scaling-ladder in hand, Jack Kenlon went up the rickety rain-spout like a cat, "gaffed"

the wooden gutter with the end of his scaling hook, and hung suspended while the flames crisped the soles of his boots. He coaxed mother and children to the edge of the roof and then, wrapping his legs around the scaling hook, tossed them one by one to a comrade on a ladder below. They lived because Jack Kenlon could function efficiently with his hands and head while hanging on for dear life with his toes.

His fourteen years' knowledge of seamanship had aided him a thousand times in fighting New York fires. Incidentally, his first experience as a rookie fireman was with a marine blaze, a week after his assignment to Engine Company 3. A schooner was enveloped in greasy smoke, but no one could locate its source. Rookie Kenlon had a hunch and, awaiting no orders, seized a line and made his way to the starboard coal bunkers. There he was found by his chief, using the hose like a veteran. It was a long time before he could overcome his desire to extinguish every fire single-handed . . . , a desire he still must fight to resist.

FROM the time of that bunker fire, Jack Kenlon's fire fighting wisdom grew until he was put in charge of all fireboats in New York Harbor. But in his

earliest years he had experiences that bewilder the sober listener. At the height of the historic blizzard of 1888 Kenlon's engine company was blocked in the mountainous snow drifts. Seizing his stoker's shovel, Kenlon led his men in shoveling, tugging and hauling until they arrived within 300 yards of the fire—when the engine pole snapped. After rustling up hose enough for the remaining distance Kenlon discovered that the hydrants were frozen stiff. Once more he resorted to an old maritime trick, and pumped steam through to thaw them out. And



Firemen under Chief Kenlon subduing a fire near the Battery which threatened all downtown New York.

after that for thirty-six hours Kenlon and his company remained on duty without food or rest.

But before piling up a hundred more such incidents, it might be well to glance briefly at Kenlon's earlier experiences on the high seas. At the age of 13 he worked for ten cents a day in the little seaport village of Annagassan, Ireland, and from the tail of the plow he followed he could see the tall-masted brigantines sweeping proudly past on an outbound cruise. He longed for the adventure and freedom they offered, and so at last he left the plow at the end of a furrow and ran away to sea.

HE SERVED his apprenticeship in the fore-castle of many an Irish coastal schooner at a deckhand's monotonous toil, saving from his meager pay until he could buy a full set of navigating instruments and teach himself the art. So at twenty he was First Officer of the *Santa Anna*, and at twenty-one commanded clipper ships sailing out of Liverpool.

But in those piping days of wooden ships and iron men, sails were just going out and steam just coming in, so John Kenlon now bent his energies to the new

study and was soon officering steamers on the old Guion Line, crossing the Atlantic in eight days. To this day Chief Kenlon holds papers entitling him to command the engine room of almost any ocean steamship.

In spite of his amazing success, John Kenlon was not entirely happy as he approached his twenty-fifth birthday. A sweet complication had entered his life in the shape of a charming colleen who had just emigrated to America. Everything within the young sailor cried out for a permanent home and domestic happiness, but he also knew that he must find a shore occupation to satisfy his adventurous spirit and equal his tremendous physical energy. Thus when he came to America in 1885 he chose fire-fighting as his life work. He not only hated fire, but had a special talent to combat it, hence his genius has been one of the happiest chapters in the history of New York City.

HE PASSED the Fire Department examinations in 1887, and thereafter every promotional test the department could give



Cheating flames of their prey. Fifty men, women, and girls, many overcome and burned, carried from a blazing factory.



The Equitable fire, where Kenlon saved a billion in securities and risked his life.

until he won his present rank of Chief in the open competitive examinations following the death of his great predecessor, Ed. Croker, in 1911.

Heroism, long service, PLUS a wider knowledge of fire fighting than that of any other living man placed John Kenlon where he is. And it's been that PLUS that has kept him there for 17 years. Even his political enemies (and he has plenty) admit John Kenlon has no peer when lives and property are at stake in a great conflagration.

There have been hundreds of such conflagrations in Kenlon's long service, but the Chief himself admits that the ghastliest was the burning of the Park Avenue Hotel in 1902. The fire started in the 71st Regiment Armory at 34th Street and Park Avenue and when the engines rolled up, the exploding ammunition stores sounded like a military bombardment. Kenlon, then a captain, was ordered to protect the Fourth Avenue car barns to the rear of the Armory. He and his men must drag their lines across the great trench of the Fourth Avenue subway which was just being dug, and in that trench lay 6,000 pounds of dynamite, exposed to the showers of sparks and embers. But Kenlon led his men across on narrow planks and with them battled for six hours in momentary danger of being blown to atoms.

BEFORE long, traveling sparks did their work and the top stories of the hotel opposite the Armory burst into flame. Hundreds of guests in the lobby and lower floors were unaware that others above were being roasted to death and when Kenlon and his company, first to enter the doomed hotel, appeared with their axes, they were laughingly asked, "Where's the fire?" One can imagine Kenlon's contemptuous glance as he and his men rushed by. There were no jokers on the fifth floor. In smoke so dense that many of the staunchest firemen were overcome, Death stalked up and down the corridor, snatching terrified victims from the very hands of their rescuers.

On hands and knees Kenlon groped his way along the smoke-filled hallways, littered with the bodies of men and women who

had fled from the comparative safety of their rooms into the draughty passageways, there to perish. Escape was impossible by elevators or stairways, lanes choked with dead or blocked by walls of flame. A crowd of panicky guests screamed at the northern end of the corridor. What was to be done? Ken-

the street below. A ladder was quickly raised, and the endangered guests were carried down in safety. Kenlon returned to the blazing corridor, now a veritable blow-pipe of flame, but his search found no more living men or women. Now, just as the door of Room 506 was blown in by the expanding heat, he sought the window and made his way down the ladder. Twenty lives were lost, but the number must have been doubled or more but for Kenlon's instantaneous strategy.

This ready strategy never had a better chance to display itself than in the Equitable fire of January 5, 1912, when Kenlon, Chief only a few weeks, met his first real test as a fire general. He was awakened at 5 A. M. and in less than two minutes had covered the mile and a half from his headquarters to the heart of the financial district. The Equitable Life Assurance Building, covering a whole block between Cedar, Pine and Nassau Streets, threatened the city like a gigantic torch.

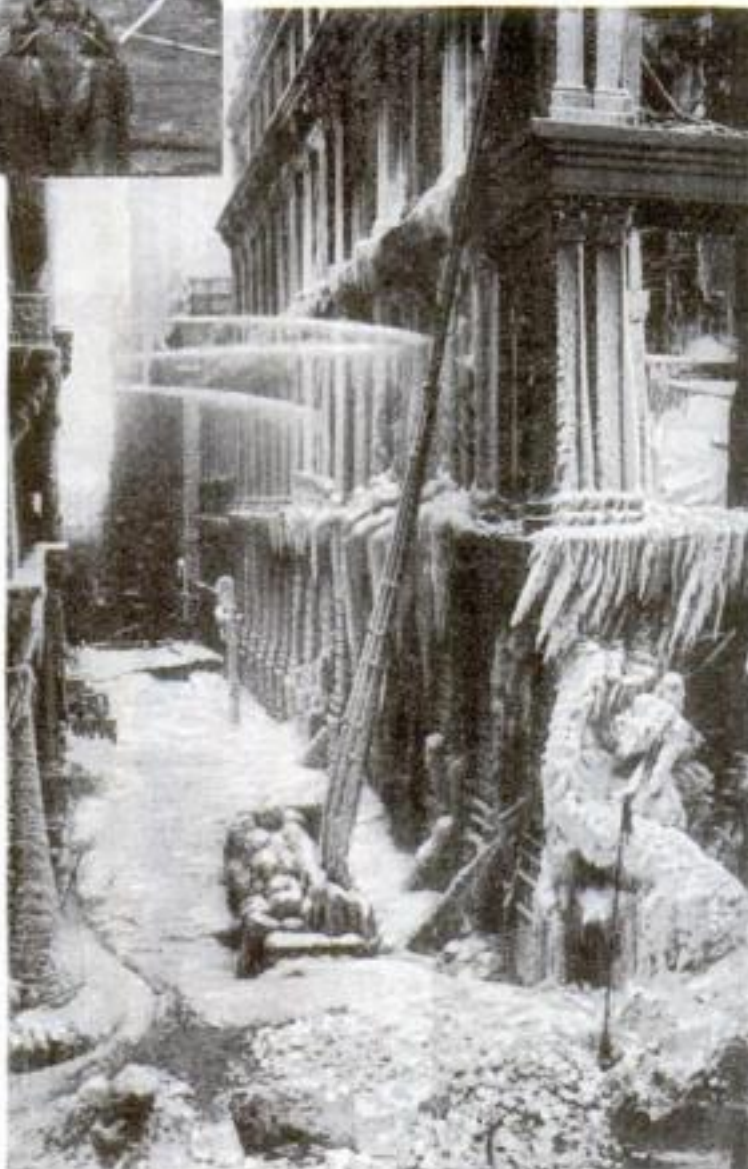
ENTERING the burning building from Pine Street, Kenlon climbed to the sixth floor, where the fire was at its peak, and calmly surveyed his battle ground. Within thirty seconds he formed his plan of attack! And from that plan he never deviated.

He saw three stakes, each richer than the last, were being played for. First, the fire must be hemmed in, confined to the interior of the building. If the flames leapt across narrow Nassau Street, they would take the richest spoils the financial world could offer. Next, the billion dollars worth of securities in the main vault of the Equitable Building must be protected. And, more important than either, hundreds of night-workers must be warned

and taken in safety from the building.

Six alarms brought rolling up the finest fire fighting equipment in the world and all eyes were on the new Chief to see what he would do with it. He threw twelve hose companies into the Equitable interior, and ordered heavy streams poured from the tops of all surrounding buildings. Water Tower No. 1 was to pump a thousand gallons of water a minute into the Pine Street side of the fire; Tower No. 2 was placed directly in line with the Equitable centre. In short, Kenlon threw a complete water curtain around the fire, thus balking its attempts to spread flaming desolation throughout New York.

Midway in the battle a new element of danger appeared. The gale increased to seventy miles an hour and the mercury fell like a plummet. The fire gained. Blocks of granite, loosened by the terrific heat, crashed from the cornices and windows. Kenlon knew the intense heat was attacking the un-



The Equitable just before it collapsed, killing Deputy Chief Walsh as Chief Kenlon was on the way to save him.

lon's mind, always sharpened by danger, was at its best. Ordering the guests into Room 506 on the Park Avenue side, he closed the door to prevent a draught and thrusting his head out a window, attracted the attention of his comrades in



Another of the almost insuperable difficulties Kenlon overcame to beat the Equitable fire and save the financial district. In the zero weather steam fire engines were frozen.

(Continued on page 167)

Magic Cell Works New Marvels

An Expert Tells How Photo-Electric "Eyes" Bring Television Nearer and Promise to Harness the Sun

By E. E. FREE

ONE sunny afternoon a few weeks ago a young man stood on the roof of a building in New York City waving a tennis racket in the air. He might have been doing his daily dozen, but he wasn't. He was exercising an eye—not his own eye, but the newest eye of science; the one that promises to make television really useful.

In a room of the Bell Telephone Laboratories a few floors below, visitors saw a virtually perfect image of the sunlit athlete swinging his racket. It was the demonstration of a supersensitive photo-electric cell, which for the first time makes possible the transmission of scenes illuminated by natural sunlight.

Television has been handicapped by the fact that natural illumination, even natural sunlight, was too weak for photo-electric cells. Powerful searchlights, or still more powerful pencil-thin light rays moving rapidly back and forth over the scene, were used. What Dr. Herbert E. Ives and his associates in the Bell Telephone Laboratories did was to make electric eyes more sensitive.

AT ABOUT the same time a German inventor, Professor Karolus, developed another new electric eye, capable of doubling the speed of translating impulses of light and shadow into corresponding electric impulses, and transmitting them. Heretofore the highest speed of television apparatus has been about 40,000 impulses a second, resulting in a motion picture only two inches square. Professor Karolus now claims to transmit 80,000 impulses a second, producing a motion picture three and a half inches square.

Shortly afterward came another triumph for the photo-electric cell when Westinghouse engineers transmitted radio motion pictures two miles, using new apparatus developed by Dr. Frank Conrad, Assistant Chief Engineer of the company. It was announced that motion picture broadcasting would begin soon.

Five years ago photo-electric cells were almost unknown. Today, connected with enumerating machines, they count



Broadcasting a daylight scene by television for the first time—an achievement that was made possible through the development by Dr. Herbert E. Ives and his associates in the Bell Telephone Laboratories of a new supersensitive photo-electric cell. The upper illustration shows Dr. Ives holding a cell that is used in television.

traffic on the streets and number paper boxes as they roll out of the machines that make them. Others measure daylight or take note of clouds that drift across the sky. Still others work the "sunburn meter" that tells you each day how strongly the sunlight is charged with ultra-violet rays. Another cell transmutes the frozen sounds of the talking motion picture into words.

In chemical laboratories electric eyes follow the progress of reactions. Astronomers, wearied with long hours of gluing their eyes to telescopes, are fast relegat-

ing this task to photo-electric cells. Even the giving of vision to the blind and the catching of power from wasted sunlight are problems that scientific men expect these cells will help them solve.

There are photo-electric cells larger than a man's head; great, staring globes of silvered glass with pupil-like windows in front as though they were fossil eyes of some gigantic Cyclops. Others look like overgrown, half-transparent sausages. Some are smaller than a peanut. It is possible to make them no larger than a pea. All have the same essential secret. They can transmute light into electricity.

YOU might mistake one of the common kinds for an ordinary radio vacuum tube. There are the same sealed glass bulb and hard rubber base and metal terminals and a similar set of metal plates and wires inside. One of these inner plates, sometimes merely a thin coat of potassium, rubidium, or other metal on the inside of the glass, is the heart of the cell. It is a kind of henroost for electrons from which, like birds on a tree-limb, they can be scared off by light.

Electrons, of course, are inside everything, for they help to make up the atoms of matter. Usually they stay inside, which is well, for the few substances like radium which do emit them spontaneously are unpleasant companions. A small bit of radium carried in a pocket will burn into your body a hole which may not heal for years.

But sometimes man desires the electrons to escape. Radio is made possible, for example, only because electrons fly out by millions when the filaments of vacuum tubes are heated. An electric battery drives forth its electrons chemically. A dynamo flogs them with magnetic forces and pumps them around through its wires. The photo-electric cell, luring them out with light rays, is a light-ray dynamo.

Like so many other important scientific events, the discovery of this dynamo was accidental. The famous German physicist, Professor Heinrich Hertz, dis-

coverer of the electric waves now used in radio, noticed that when an arc lamp was illuminated by rays of ultra-violet light from another lamp near by the electricity passing through it was increased. If two or three open electric arcs, like the old-fashioned street lamps, were placed side by side, all of them burned more powerfully and consumed more electricity.

Another German physicist, Dr. W. Hallwachs, traced this common fact to the emission of electricity from one of the metal rods used in the arcs. This was in 1888, and the electron had not yet been discovered, so all that Dr. Hallwachs knew was that electricity escaped. But the development of the marvelous photo-electric cells of the present day is directly traceable to his experiments.

Photo-electric cells must not be confused with the often-mentioned selenium cells, made of wires or plates of that semi-metallic element. What happens to selenium when light falls on it under proper conditions is that its resistance to the passage of an electric current decreases. Selenium cells can be used for some of the light-detecting and light-measuring duties of the true photo-electric cells, but most modern experimenters consider them less suitable.

THE present widespread use of photo-electric cells has been made possible in great measure by the development of modern radio amplifiers. The records of sounds, for example, which constitute the talking motion pictures are usually printed photographically on the edge of the motion picture film as tiny light and dark cross lines or lines of tiny waves.

A slender beam of light is sent through this succession of lines. As the film runs on, this beam varies in strength when it passes a dark mark or a light one. It then enters a photo-electric cell which converts these light variations into electric ones, just as sounds themselves produce tiny electric vibrations in the microphone of a broadcasting station. But amplifiers are necessary to magnify the feeble photo-electric currents thousands of times until they roll out in powerful volumes of sound to fill the largest theater.

DR. D. C. STOCKBARGER, of the Massachusetts Institute of Technology, has used combinations of photo-electric cells and amplifiers to telephone over a beam of light just as one ordinarily telephones over a wire—a procedure conceivably of much use in warfare, for communications could be sent over the beam of a searchlight and could not be read by the enemy.

In my own laboratory we have a photo-electric organ, built by Dr. Norman Hilberry and C. A. Johnson and first demonstrated before the New York

Electrical Society. A beam of light is interrupted at regular intervals by passing it through holes in a rotating metal disk. This beam then enters a photo-electric cell, which emits a musical note fixed by the number of interruptions each second in the light beam. Few real organs produce more perfect or beautiful tones.

For the photo-electric burglar alarms so often suggested beams of light shine into concealed photo-electric cells. Let an intruder step between and promptly a signal goes to the attached electric amplifiers and an alarm sounds. If desired, such devices could be arranged to emit poison gas in front of a safe or to shoot down an intruder without waiting for the police to arrive. C. A. Johnson has developed a photo-electric timing device for races which is started and stopped automatically by contestants' shadows at the start and finish lines to



A photo-electric cell apparatus for measuring the light-transmitting properties of ornamental glass globes for street lamps—in use by General Electric Company.



This photo-electric cell is so sensitive that it will note the passing of the faintest cloud and set in operation a needle to record it on a weather chart.

an accuracy of a hundredth of a second as against a tenth of a second—the best attainable with a stop watch. Even greater accuracy is possible, for Drs. E. O. Lawrence and J. W. Beams have proved in the Yale University laboratories that the electrons respond three billionths of a second after the light ray strikes the cell.

Other arrangements of photo-electric cells, light rays, and amplifiers have been used in industry to ring a bell when the mercury of a thermometer rises to a given point, when a light spot reflected from any electric measuring instrument reaches a certain mark, and when factory smoke is denser than health laws permit.



Two extremes in photo-electric cells—the eleven-inch bulb made by L. T. Garner, University of Illinois, is said to be the world's largest. The other cell is an ordinary-sized one.

The density of smoke can even be measured; for the blacker it is, the less light it will let into the cell and the less electricity the cell will produce.

Another application is the daylight meter; its cell is pointed at the sky instead of at a smoke-stack. At the General Electric Company laboratory at Schenectady, New York, Dr. L. R. Koller records every passing cloud on a chart attached to a photo-electric eye.

THE proportion of the healthful, invisible ultra-violet rays in sunlight and in ultra-violet lamps can now be determined by a special variety of photo-electric cell, and Dr. R. C. Burt, of Pasadena, Calif., uses the cell in a "sunburn meter" to determine how sensitive any person is to the sun's rays.

The General Electric Company uses the cell in tests to measure light of many kinds of lamps and to ascertain how much illumination passes through various types of ornamental globes. Thickness and transparency of cloth and paper and even shades of color are also measured in the mills by the cell, and with the colorimeter, devised by Professor A. C. Hardy, of the Massachusetts Institute of Technology, manufacturers can measure exact shades of color in dyes and dyed materials, and packers can sort fruits according to ripeness as indicated by color.

No less an authority than Dr. Ives suggests the possibility of catching the enormous energy of sunlight in giant solar dynamos working on the photo-electric principle, providing vastly more power than the world will ever need.

Even more interesting, because more definitely in sight, is the possibility that photo-electric devices may enable blind persons to read ordinary type "by ear." Each letter of a page, scanned by the photo-electric eye, would be translated automatically into a recognizable combination of sounds. If these remarkable cells did that and never anything more, it would justify their claim as one of the greatest gifts of science to mankind.

A Mystery of the Blood Solved

Experiments Show That the Heart Pumps Five and One Half Quarts Through the Human Body Every Minute

By

GEORGE LEE DOWD, JR.

A PUZZLE of physiology, three centuries old, was solved the other day when four physicians of the University of Louisville, School of Medicine, Kentucky, succeeded in measuring the output of the human heart. The marvelous little engines that drive our bodies, they found, pump blood at the rate of about five and one half quarts every minute!

This discovery was the result of experiments by Drs. W. F. Hamilton, J. W. Moore, J. M. Kinsman, and R. G. Spurling, in which they injected a harmless dye into a vein of the body; then, by measuring the concentration of the dye in samples of blood taken from an artery every second, determined the heart's output.

It marks one of the few important advances in knowledge of the blood stream since 1628, when the great English physician, Dr. William Harvey, gave to the world the discovery of the circulation of the blood. And, by happy coincidence, it comes just when men of science the world over are commemorating the three hundredth anniversary of Harvey's work which, they tell us, probably has done more than any other single modern achievement to relieve human suffering and promote health and happiness.

The latest contribution of the American experimenters, important in itself, serves to emphasize the amazing genius of the experimenter of bygone days who used crude equipment so effectively that three centuries have but confirmed and elaborated the facts he revealed. Today Harvey is hailed as "the father of modern medicine"; for by his discovery of the pumping system which sends blood coursing through the body, he laid the foundation for modern understanding of the machinery which

Dr. William Harvey, "father of modern medicine," demonstrating his discovery of the circulation of blood in 1628 to Charles I, of England.



From a painting after Robert Hannah

supplies us with fuel, energy, and life.

To make the acquaintance of William Harvey, we must travel back to the England of Shakespeare and of Francis Bacon. It was during the reign of Queen Elizabeth, in 1578, that Harvey was born in the port of Folkestone, the son of a well-to-do Kentish yeoman. At 15 he went to Caius College, Cambridge, to follow a career of medicine. Six years there and the thirst for further knowledge drew him to the capital of world learning of that day, the ancient University of Padua in Italy. There he came under the

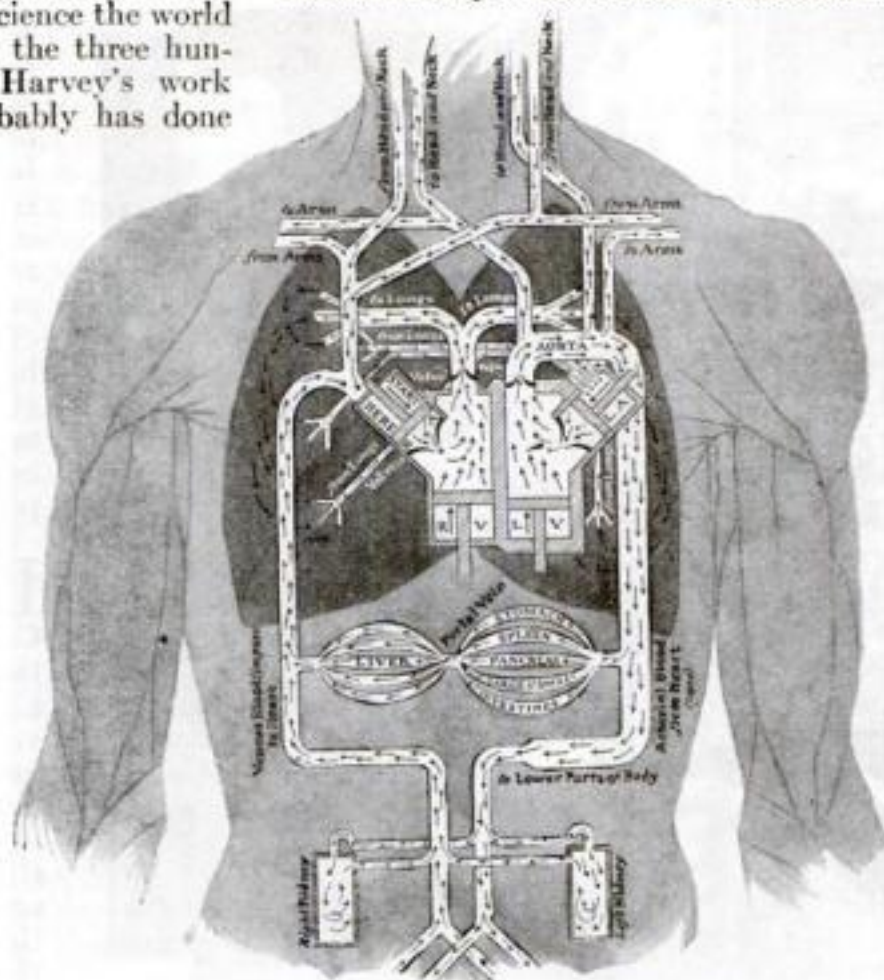
tutelage of Hieronymus Fabricius, the most distinguished anatomist of the time.

Although the anatomical structure of the heart was known, no man had conceived of it in its true rôle. So if we could have joined young Harvey in the ancient lecture hall at Padua, we should have heard Fabricius expounding a doctrine something to this effect:

To every part of the body ran a double set of channels: the veins which carried nourishing blood, and the arteries which carried mysterious "vital spirits" of life. It was the task of the stomach to manufacture food into blood, which then passed through a large vein to the liver. There it was refined with "natural spirits." Other great veins running upward and downward carried this refined blood to nourish the body. The upper vein ran through the right auricle of the heart.

The heart was the retort where the "vital spirits," carried by the arteries, were brewed and mixed with blood. It was the mysterious source of life and heat for all parts of the body.

HARVEY'S fellow students apparently accepted all this without question. But Harvey's question-mark mind could not accept it without further demonstration. One teaching in particular filled him with doubt. Fabricius had shown that there were set at intervals within the veins of the arms and legs little valves like canal locks. They were in the form of pockets, and their mouths, always directed toward the liver and heart at the center of the body, were set to catch the outward tide of nourishing blood. Fabricius had an explanation. Since the legs and arms hang downward, he said, they would drain the blood from the rest of the body were it not for these valves. *(Continued on page 159)*



This diagram makes clear the operation of the marvelous system of "pumps" and "pipes" by which the blood is circulated through the body.

Sea Water Runs Strange Dynamo

French Scientist Demonstrates How Electric Power Can Be Produced by Harnessing the Ocean's Varying Temperatures

By EDWIN KETCHUM

POWER from the sea—power in vast, incalculable quantities—is the glittering promise held out by Georges Claude, famous French physicist with revolutionary industrial successes already to his credit. For at an experimental plant on the Meuse River, near Liege, Belgium, Claude has just reported that he is successfully drawing forty kilowatts of electric power directly from the water's natural heat.

And now Dr. Claude is proposing to harness the ocean to drive dynamos and yield electric power in a manner that is startling in its ingenuity.

No fickle tide would drive his machines. Instead, Dr. Claude points out, there is a far more dependable source of energy. The top of the ocean is hot in comparison with the bottom, which is cold. That difference in temperature, Dr. Claude says, will run a turbine.

When Dr. Claude told the French Academy of his plans a few months ago, as reported at the time in *POPULAR SCIENCE MONTHLY*, he exhibited a glass model to show how the scheme would work. Before their astonished eyes, he poured water into a jar and warmed it electrically to a temperature of eighty-five degrees F.—about the temperature of tropic surface sea water. He hooked it up by tubes to a second jar which contained cracked ice to a depth of several inches to represent cold water from the depths of the ocean. In the top of this jar was a tiny dynamo wired to three lamps, run by a slotted turbine wheel against which steam would spurt.

WHERE was the steam to come from? Not from water at eighty-five degrees, surely? Everyone knows that water does not boil until it reaches a much higher temperature—212 degrees, to be exact.

Yes, but that is no longer true when you boil water on a mountain-top—because the lessened pressure of the atmosphere allows it to boil at a lower temperature. Suppose nearly all of the pressure were gone—that

WHEN Dr. N. L. Otto a half century ago invented the internal combustion motor, he turned gasoline, a useless product, into "liquid gold" and made possible the motor vehicles of the world. He had found a new kind of power. This article tells you of the daring plan of Dr. Claude, French physicist, to use the differences in temperature between the surface and the depths of the ocean to produce electricity. Unlike steam, depending upon a dwindling coal supply, and gasoline, relying upon diminishing crude oil, his scheme taps a source as lasting as the sun and the ocean.

you were to go higher until you created a near-vacuum over the water?

Dr. Claude produced a rubber tube and attached one end of it to a stop-cock in his glass apparatus. The other end he fastened to a small vacuum pump that would suck out nearly all of the air in-

side. Then he started it chugging.

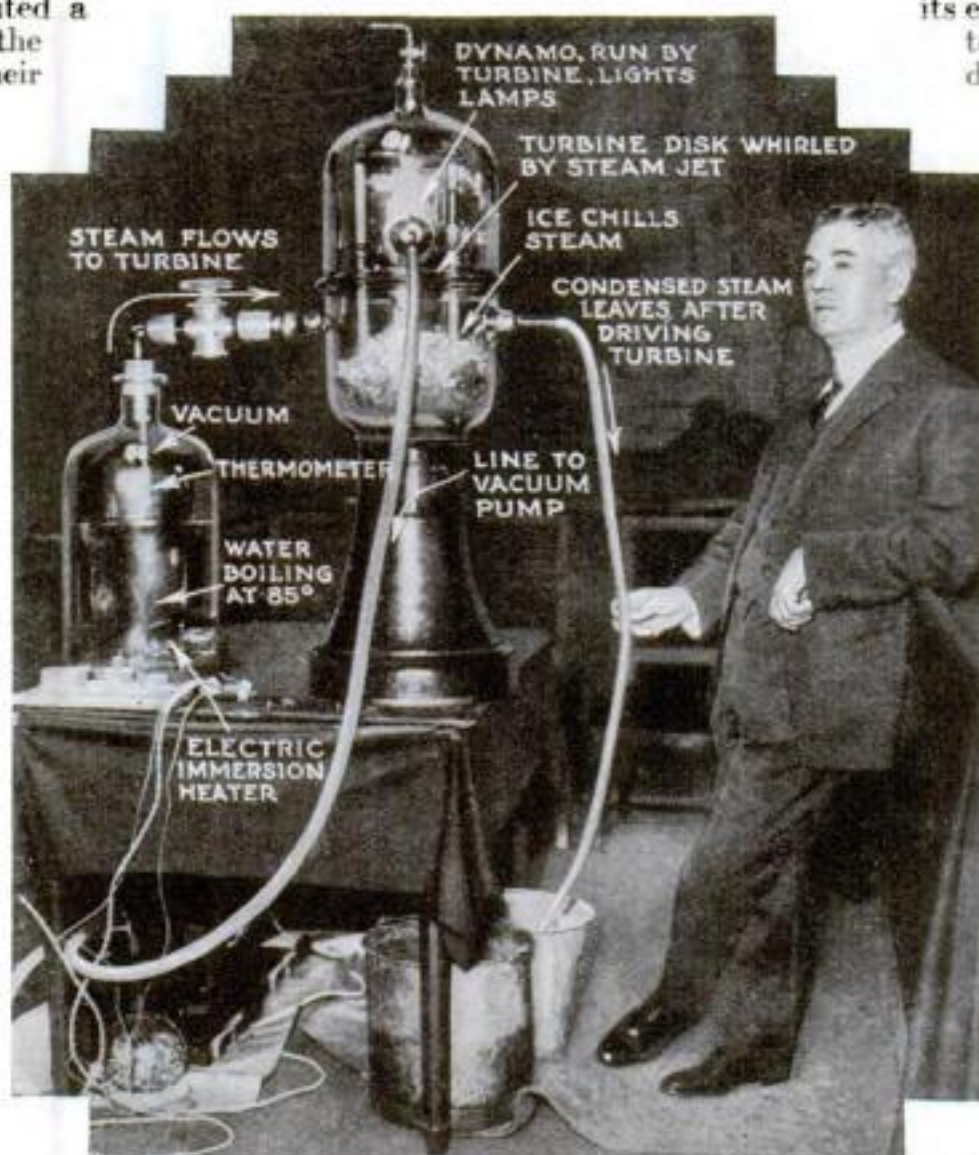
Soon the warm water commenced to boil merrily—water that would not even scald you were you to put your hand in it! Dr. Claude shut off his pump, but the water kept on boiling. Steam filled the glass tubes. A whirl, and the turbine wheel commenced to spin—faster, until it was whining at the rate of 5,000 revolutions a minute. The lamps in the top of the jar glowed brilliantly.

ELECTRIC power from the sea could be captured as easily, Dr. Claude told his audience of distinguished scientists. At island or shore power houses in the tropics, limitless supplies of warm water would furnish natural steam to run giant turbines. After the machines were set running, cold water pumped from the depths would condense the used steam and maintain a suction that would yield fresh vapor.

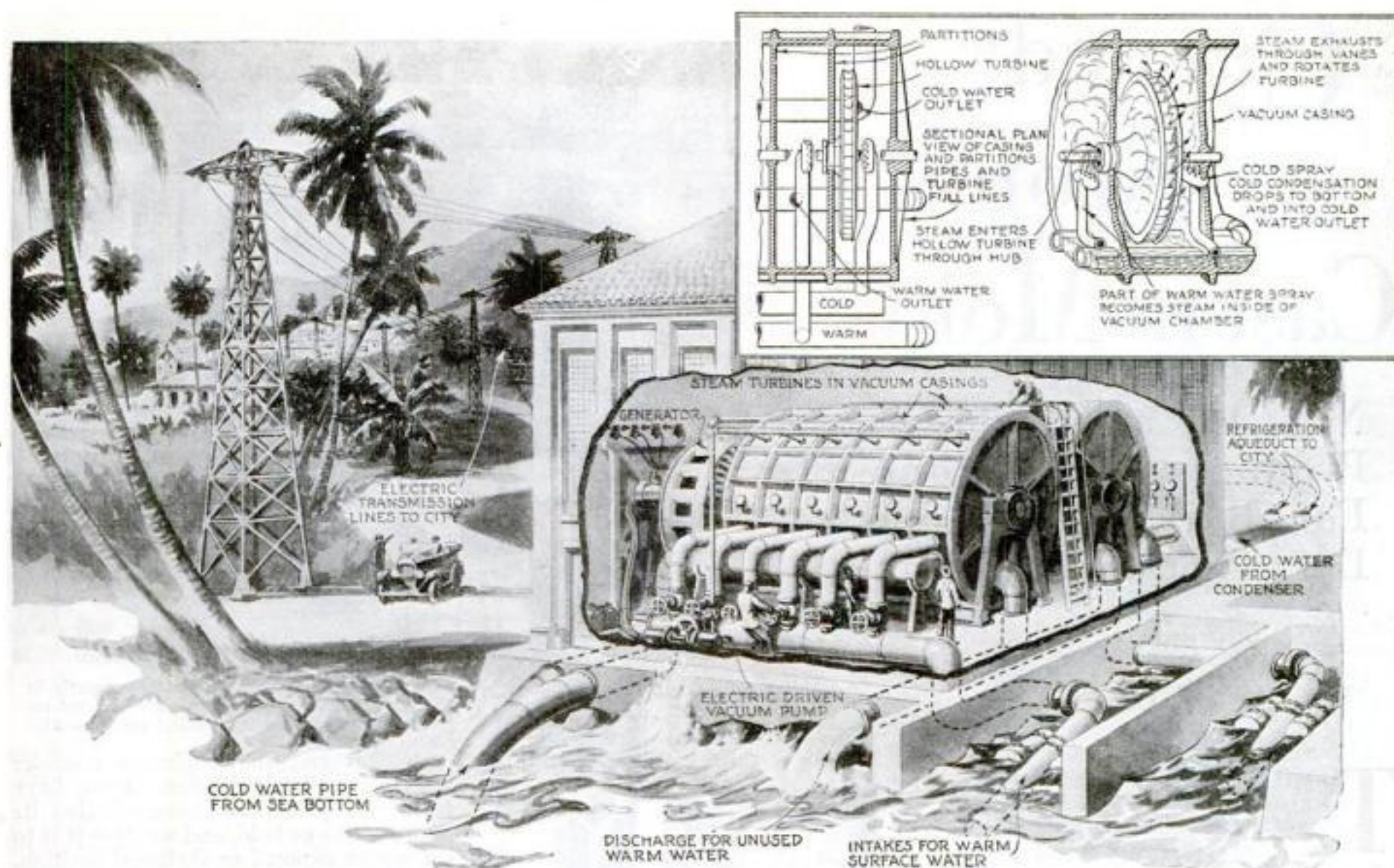
Could this eminent man—an inventor of a wonderfully successful process of making ammonia industrially from its elements, and discoverer of a way to liquefy air and capture for industry its oxygen and hydrogen—could he be mistaken? Can anyone tap the ocean's warmth for power?

After all, engineers observe, it is not as it might appear, "getting something for nothing." Actually it is a new way to capture energy from the sun; already, in African deserts, great mirrors, fragile and expensive, collect the sun's heat and drive steam engines. And Dr. Claude's more elaborate scheme must be admitted to be perfectly possible in theory.

BUT critics were not slow to pick flaws in it. Compare, they suggested, the kind of steam that Claude would use with the vapor that drives modern industrial turbines—mighty machines whose windmill-like vanes are pushed by steam pressure on one side and pulled on the other by the suction of condensers that literally destroy used vapors with torrents of cold water. Raging fires of the boilers hurl their steam



Georges Claude demonstrating his dynamo driven by steam from water which, due to a vacuum above it, boils at 85 degrees F.



Artist's conception of one of the giant steam turbine power houses proposed by Georges Claude to generate electric power from tropical ocean water. Part of the building is cut away to show the turbines. Above: Diagram of apparatus.

through pipes under pressures of two or three hundred pounds to the square inch—while the most that Claude could hope for in his low-temperature vacuum apparatus could be a weak jet of only a thousandth as much pressure. Better to measure its energy in fly-power instead of horsepower!

EXACTLY, Dr. Claude agreed. And that was why in his latest project he proposed to use machinery of such startling dimensions that he would make up in quantity what he lacked in quality of his steam.

A manufacturer may allow himself but a tiny margin of profit on a single article and still amass a fortune if he could sell his product in huge enough quantity. So Dr. Claude would draw through his enormous machines millions of gallons of water from the ocean's vast, inexhaustible reservoir and, extracting just a little of the heat energy of each, reap a harvest of, say, fifteen thousand horsepower in a single power plant.

One other objection was raised. Pumps must lift huge quantities of water. Would there be any power left over after Claude's station ran its own pumps? Instead of answering, he tried it to see.

At a point on the Meuse River, in Belgium, he found the surface water just forty-six degrees hotter than that at the bottom, and there Claude set up a miniature turbine and a generator of fifty kilowatts capacity—enough to supply a small factory with all the power it needed.

Following his tests, just concluded, he told the Academy of Sciences that he could obtain power up to four fifths of the dynamo's capacity from the heat of the River Meuse. It was not only enough

to run the station's pumps, but more than half was left to distribute as electric power to do useful work. In fact, the pumps were not at all hard-driven, because the very suction inside the turbine, produced by the existing vacuum, saved the pumps a large part of the trouble of lifting the water.

Now Dr. Claude proposes first a larger experimental station, and then a full-sized commercial plant. One of his projects is to establish floating power stations, great islands of steel, to dot the tropic oceans and, riding on anchored pontoons, to supply electric power by submarine cable to distant coasts. Such stations would be of huge capacity, possibly as much as 150,000 horsepower each. In more immediate prospect are coastal stations of perhaps 15,000 horsepower, distributing cheap power from the sea to neighboring cities and villages. Cuba, the Bahamas, Hawaii, and Ceylon afford admirable sites, Claude says. Our artist depicts here his conception of such a station, with its mammoth low-pressure vacuum turbines and its utter absence of smokestacks or coal wharves ordinarily associated with power plants.

IN SUCH a plant, according to the Claude vision, great pipes near the surface suck in the tepid surface water to make steam, while a huge tube plunges a mile or more into the ocean to draw frigid water for the condensers from the depths. At the starting signal, a vacuum pump voids the turbine shells of air and is then shut off as the twenty-foot wheels slowly commence to revolve under the impulse of thousands of jets of low-pressure steam.

While the main object of the plant is to supply electric power, it will have one by-product of tremendous importance,

the great French physicist points out. Waste water, after its use to condense steam, need not be returned to the sea. Since it will still be only a few degrees above freezing temperature—veritable ice-water—it can be piped in vast quantities to surrounding towns and there used profitably for refrigeration. Run through cooling pipes, it will dispense with ice in household and commercial iceboxes; it will cool whole houses; it may even be led through blistering streets, in huge troughs, to chill the entire outdoor air. Imagine what it would mean to a city sweltering under a tropic sun to have a thousand tons of ice an hour dumped in its streets—the equivalent of the cold torrent from a Claude power plant.

ALTHOUGH Dr. Claude and his associate, Prof. Paul Boucherot, were the first to demonstrate the practical possibility of power from the sea's heat, Dr. Claude himself points out that an American engineer, Benjamin J. Campbell, originally conceived and outlined such a plan. Campbell's scheme was to use hot and cold sea water indirectly, transferring their energy to carbon dioxide to run the machinery.

This would substitute small high-pressure turbines for Claude's mammoth vacuum machines, but it has the disadvantage of added complexity.

Another heat-transfer scheme somewhat reminiscent of Claude's power plan was used for years in a French chemical factory, until the pipes became corroded, where waste heat from a vat was recovered and put to work. Now engineers are watching Dr. Claude's project with eager interest, to see whether he has evolved a means for profitably tapping brand-new power sources on a colossal scale.

"Carved" Stone Cast in Molds

New Art and Industry
Produces Decorations
For Buildings Which
Defy Time and Elements

By

WYATT BRUMMITT

TIME was, the creation of architectural ornament was wholly a matter of the mason's trusty chisel and stubborn stone. But scientific development in cement and concrete has produced a stone which may be given any shape, texture, or color without reference to a chisel until the final dressing.

This new architectural material, called "cast stone" or "cut, cast stone," is, at one time in its career, as easily molded to any form or space as plaster of Paris; but there its resemblance ends, for when this artificial stone has set, it grows stronger and stronger, increasingly impervious to ravages of time and the elements.

In its final form, cast stone may be anything from a massive, classic column to a delicate bit of tracery, from stone facing for a great office building to a simple window sill for a bungalow. But it always has its beginnings in the scientific mixture of Portland cement, water, sand, and some sort of coarse aggregate—clean marble chips, granite, or other stone, chosen for particular color or texture.

Cast stone ornaments are first conceived in the mind of the architect. Then trained artists employed by the cast stone manufactories make complete drawings and prepare patterns from which clay models or wooden patterns are made. From these, molds are made in plaster, glue, or sand, glue being used when several reproductions are desired.

Now the concrete mixture is definitely determined—one of the most important aspects of the work, since scientific research has shown that concrete is an accurately determinable product, in which the proportions of ingredients are vital factors. In designing the con-



The making of the wooden patterns exactly in the form of the cast stone ornaments desired requires utmost in care and skillful workmanship.



The almost unlimited possibilities and adaptabilities of cast stone are shown by this highly ornamental church window, with bold and delicate lines in one design.

An accurate clay model of the finished ornament is often the first step after the drawing is made. Here a sculptor is putting the finishing touches on such a model.



Preliminary work for casting the concrete capital of a column. At the left of the illustration above is shown the pattern made from an architect's drawing, and, at the right, the mold, made from the pattern. In this mold the stone will be cast.

crete mixture, the engineers consider whether the finished ornament will have to carry any load or stress, whether its lines are fine or bold, and whether it is to occupy an exposed or sheltered position.

After a casting has been made and has set, every care is taken to insure its curing under ideal conditions, insuring a dense, strong, and satisfactory cast stone.

Eventually the casting is ready for finishing and from this stage on, it may be handled exactly as natural cut stone. It may be rubbed, honed or machine grooved by mechanical means. Or it may be bush-hammered, crandalled, axed, pointed, or otherwise treated by hand.

The installation of cast stone units involves few methods which are unfamiliar to workers in stone. The feasibility of casting them hollow, however, decreases many of the difficulties commonly encountered in such work.

Modern science demands maximum plasticity of much with which it deals. Iron, steel, glass, ceramics, and many other materials are first reduced to complete or partial plasticity before they can be utilized to best advantage. Stone has now been added to the list of plastic materials and a renaissance in architecture is the inevitable result.

Thus the buildings of modest small cities and towns may soon have qualities of beauty heretofore impossible for them. At the expense of a few thousands of dollars they may be adorned with the inspiring art that was produced for ancient Greek temples only by lifetimes of sculptors' labor.

Windows—the Eyes of the House

Here Are the Details, Advantages, and Weaknesses of Sashes, Casements and Plain, Plate and Ultra-Violet Glass

BY JOHN R. McMAHON

KING Rollo was a merry old soul, but he needed cash, and the royal treasurer said: "Sire, there is none, and we've already taxed the daylight out of the people."

"Is that so? Ha! I have it!" chuckled the gay monarch. "I'll tax their daylight! Put five doubloons on every window in a man's house."

"Your majesty is a genius!" exclaimed the treasurer in homagelike ecstasy. "No other king ever thought of coining sunshine. The revenue will be abundant, for no one can live without light."

It was indeed a grand scheme which other rulers hastened to adopt.

Britain did not abolish her window tax until 1851 and France may still have it in mitigated form.

America revolted for free tea and daylight in 1776. But in spite of the freedom from government levy our ancestors' windows remained few and small. The hampering factors were the cost of glass and the difficulty of heating a house with open fireplaces. Today windows are as cheap as walls and the modern furnace has surplus ability to cope with the extra heat losses through glass. Factories embody more glass than wall surface and as to houses, some architects moan that too much glass is robbing them of the wall expanse they need for artistic effect. If King Rollo could visit America today his mouth would water at the window-taxing possibilities—a year's revenue for his kingdom from a moderate-sized town.

BUT how many windows does a house really need?

That question is seriously put by many prospective home builders who do not like a flip-pant retort. Yet the fact is that the sky is the limit. As many as you want. The average house has windows to spare. Every plan is amply windowed. The real question nowadays is not how many windows but what kind.

How many kinds are there?

Perhaps half a dozen if we include the pivoted window, several varieties of sliding windows and the hinged or casement window. Until recent years the sliding counterweighted pair of sashes was almost universal in American houses. Now



A geared mechanism with which, by turning the crank, the casement can be swung to any position desired and firmly locked there. It works through the screen. The crank can be detached if one wishes.



The casement, now fashionable, is far from new, being a revival, with improvements, from Elizabethan and earlier times. Unquestionably it is far superior in its beauty to sliding sashes.

their supremacy is challenged by the modish casement, which, for all its airs, is a revival from the Elizabethan and yet more ancient times.

How does the balanced window operate?

On each side of the frame are vertical weight boxes, or wells, covered by trim. The weights are attached to the sash by

cords over pulleys and run up and down in the boxes, balancing the sashes so they are moved with little effort. Each sash has two weights, one on each side. The total weight for the lower sash should be half a pound less than the sash, while for the upper sash it should be half a pound more. The difference makes a tight closure of the two sashes. It is necessary to weigh each individual sash and then match the counterweight to it, for the panes of glass that are nominally alike vary to some extent in thickness and therefore in weight.

Are there any improvements on the balancing layout?

Yes, among them a cord-fastening device instead of the usual method of tying through an eyehole at the top of the cast iron weight. The eyehole is rough and tends to cut the cord; the knot may come loose and some-

times the eyehole breaks. The weight boxes are accessible through removable strips in the window grooves on each side of the lower sash, held in place with screws. Remove the screws, pry out the strips and you can make repairs or replacements. Iron weights are cheap. Only the best cotton sash cord should be used. Chains and metal tapes have been devised, but it is doubtful if they are much better than good cord, which will last many years. Lead has special merit as a counterbalance in some cases, since it is 80 percent heavier than cast iron and

A casement bolt with a cam which is turned after the bolt is shot home, drawing the window so tight against the frame that it is absolutely weather-proof. A piece of paper is held fast in the joint.

for that reason it permits a smaller cylinder. It is useful where windows have narrow side frames with limited weight space or when two or three windows are set close together. For remodeling jobs, especially in masonry where openings are difficult to alter, lead saves time and cost.

IS THERE a system of sliding windows without counterweights?

There is, and it has certain advantages. It consists of a coiled tape spring attached to each side of the sash. The tension balances the sash and makes it easy

to operate. The spring is said to retain its elasticity indefinitely and the metal tape is of a composition that resists corrosion. The device is housed usually at the upper sides, in a round box that requires little space. The boxes may be installed above the window to permit very narrow trim at the sides or the assembly of two or more windows close together. The space required between adjacent windows is reduced to one third compared with the ordinary counterweighted installation.

Are there other improvements in sliding windows?

Yes. One scheme provides for shoving the window upward and out of sight within the wall. This calls for special construction in a house that is being built and must be embodied in the architectural plans. A less exacting device combines the sliding and the hinged features and a sash can be raised and lowered in the usual manner, or can be pivoted to swing inside the room. This invention avoids one of the principal disadvantages of the ordinary sliding sash—that the outside is not easily reached for cleaning. This is, in fact, a window of rare merit.

What is the argument for the casement against the sliding window?

That it can be opened fully to obtain the maximum of air while with ordinary balanced sashes only half the opening is available. There is convenience in cleaning. The casement frame is neat and compact, dispenses with much trim and has less surface to keep painted.

ARE there any drawbacks to casement windows?

They usually exclude outside blinds or shutters, if that is a drawback. Some types are not quite proof against beating rains. If the fastening mechanism is poor or dependent on individual care, wind may rattle or slam the partly open casement with damaging effect. It is best to have an automatic lock, whether of the keyed gear or another kind, that holds the window securely in any position.

Are these windows made only in metal?

No, they are also obtainable in wood. The metal kind, as being incombustible, belong specially in masonry walls, but are also used in frame buildings. Metal requires less material with more space for glass and it does not warp, swell and bind. If steel, it is presumably of a kind not inclined to rust. Unless the metal is bronze, it is better to take no chances, but to see that the underside of the frame is painted before installation and the exposed parts kept painted. Red lead should be used for an undercoat on metal.



Mr. McMahon's articles discuss practical problems that confront every house builder. They may solve your problems. But if you need special advice write to Mr. McMahon in care of the Homebuilding Department, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York City.



Sleeping porch windows with slats that can be set at any angle admitting air, excluding rain and yet providing privacy.

A combination sliding sash and casement window. It moves up and down, but also swings inward, admitting the maximum of air through the entire frame, making washing the glass easy.



Why can't blinds or shutters be employed with casements?

Because it is impractical to have two sets of hinges on each side of the opening and a duplicate mechanism for opening and closing. This objection is removed



This drawing shows how several kinds of glass may be used for various windows of a house, all according to the particular requirements and uses of the several rooms—plate, prism, ultra-violet and plain glass.

with inward-opening casements, but they are not entirely weatherproof.

Can metal weatherstripping be applied to casements?

Yes, at least to a number of types and in a manner similar to that used with other windows. When the window closes, a V-shaped strip of metal enters a corresponding groove, making an airtight joint. This is the best and most permanent device. It is generally installed by skilled workmen employed by the manufacturers, who do not care to sell the materials without service. The cost may be around \$5 a window. Doors are similarly treated. Of course it is less expensive to weatherstrip with felt or rubber attached to wood, but rubber deteriorates, and felt is subject to moth attack.

What about window screens?

THE best material is copper or bronze. For sliding windows a removable screen that covers half the total opening is cheapest. It is better to have a full screen, so that either sash can be opened to any extent. This may be hinged at the top and hooked at the bottom or held with metal buttons at the sides. But such an arrangement hampers outside cleaning. One answer to this may be side-hinging of the screens, using a pivot hinge device to save undue labor in spring and fall. Another way out is a somewhat recent invention—an inside screen that rolls up like a window shade on a spring roller

concealed beneath the window frame top. For casements the usual method is an inside screen with openings in its frame bottom through which pass the control rods of the window. Anyone who wishes to assemble knocked-down screen frames or make them himself should know of the zigzag metal fasteners that are driven into wood and obviate the use of nails, screws and corner braces. A couple of these fasteners on each side of a miter joint will hold it securely and save much labor.

How many kinds of glass are used in win-

dows at present in the average house?

There are three principal kinds; ordinary window glass, plate glass and the sort that transmits ultra-violet rays. The first comes in several qualities and thicknesses. It is not absolutely flat but has a certain waviness of surface, hence the distortion of objects seen through some parts of a pane. There are generally two grades in quality, which concern the extent and location of seeds, burns, specks, blisters, scratches and waves. It takes careful examination, with a copy of the rules in hand, to determine the grade. The buyer can at least look for labels, see that offered material is fairly uniform, and object to glaring defects.

What are the thicknesses in ordinary window glass?

Single strength, according to U. S. Government rules, is $\frac{1}{10}$ to $\frac{1}{12}$ inch and double strength is $\frac{1}{8}$ to $\frac{1}{9}$ inch.

There are

(Continued on page 160)



English Olympic athletes taking ultra-violet ray bath. Left to right: J. R. Major, V. P. Brown, F. Gaby (hurdler), S. Ferris (Marathon), H. A. Johnston.

Electric "Suns" Fight Disease

Powerful Ultra-Violet Lights, Which Can Be Used in the Home, Are the Latest Tools of Physicians

By THOMAS ELWAY

A PUBLIC-SPIRITED Englishman, Lieutenant Colonel G. S. Hutchison, took five poor pit boys from British coal mines on a "sun-bath" outing to Switzerland, where the natural sunlight has long been known to be exceptionally beneficial to health. The lads grew amazingly strong, but obviously this expedient was impossible for all the boys and men deprived of sunlight by their work underground.

Colonel Hutchison cast about for some other plan; finally he had a battery of artificial sunlight lamps installed at the Sherwood Colliery, Mansfield, England, to give treatment with the artificial rays.

A few weeks ago the results were announced. Fifty boys who had received the rays regularly had gained an average of four pounds, six ounces in weight in a few months. Fifty similar boys without the treatment gained an average of only two pounds, ten ounces. The treated boys grew in height an average of a little more than three quarters of an inch; the others grew less than half an inch. Thus concludes the first stage of what is perhaps the most extensive test so far made of the effects of these artificial ultra-violet rays on persons not actually ill.

But for the person who thinks of buying an "artificial sunlight" lamp there are two important questions:

Are you sure of just what you want its rays to do and do you know how to use

this powerful new light medium safely?

If a person is sick, don't use the rays. See a physician. But to keep well people healthy they may be useful. Only you must learn how to use them, as you would learn to use an axe or a gun or any other dangerous tool.

Thousands of "sunlamps," "alpine ray lamps," "actinic lamps," "phototherapy lamps" and so on have been sold in America. All claim the same essential—the invisible ultra-violet rays which are present in summer sunlight, especially in mountain climates. One of the great discoveries of modern medical science is that these rays are extremely valuable to human health, perhaps essential to it.

During the summer season any person who is out of doors a reasonable part of the time probably gets all the ultra-violet rays he needs. Modern clothes for women, constitute perhaps the greatest step toward health ever taken. Bathing suits are still better. Nothing could be more apt to build a strong and healthy body than to live all summer in an abbreviated bathing suit even if the only bathing were sun bathing.

Winter is the dangerous season. Then the ultra-violet *(Continued on page 162)*

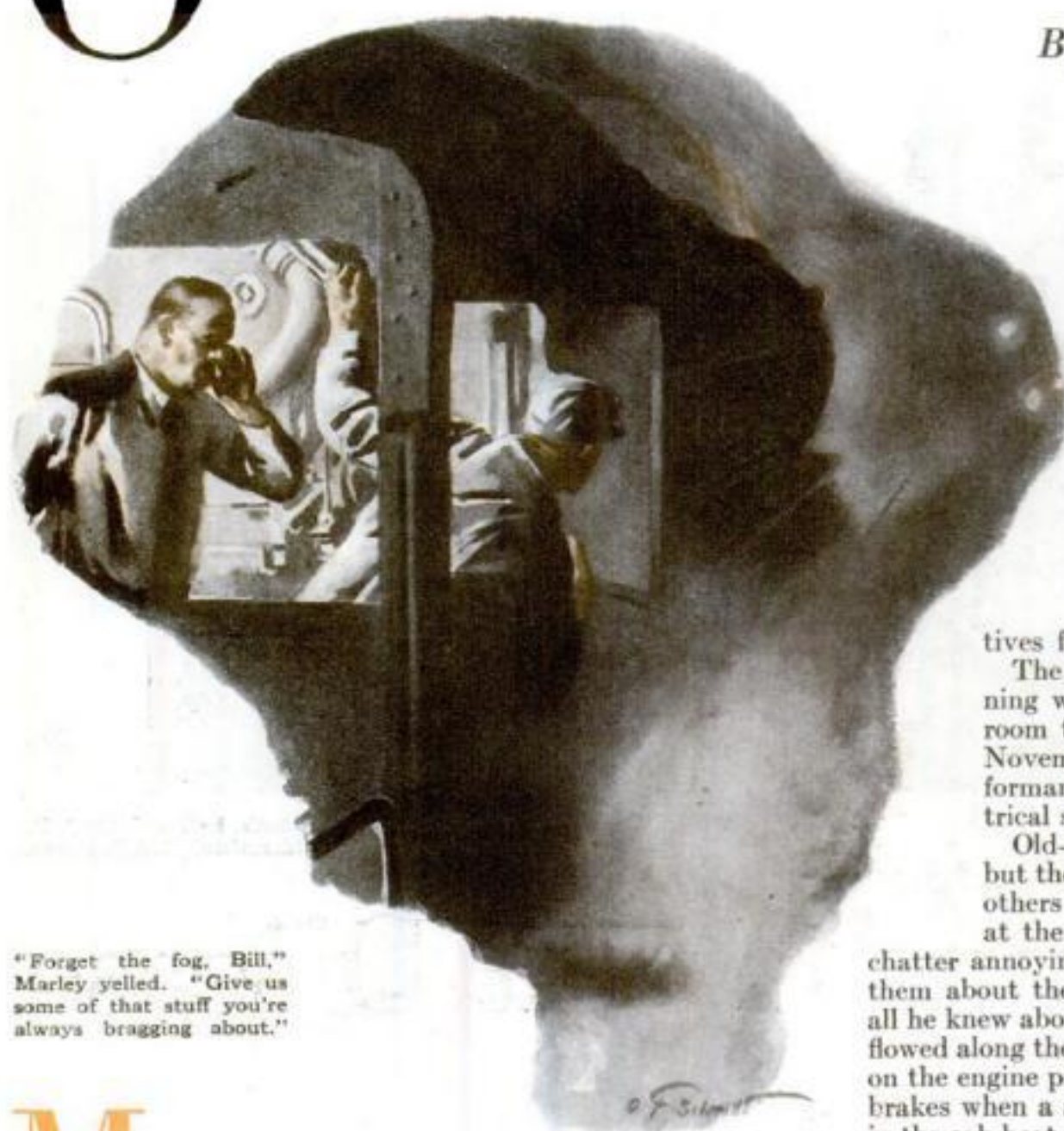


A racing greyhound taking treatment.

ON TIME *in the* FOG

By LEO F. CREAGAN

Illustrated by Oscar F. Schmidt



"Forget the fog, Bill," Marley yelled. "Give us some of that stuff you're always bragging about."

MARLEY never did learn the identity of the chief conspirator in the plot to humiliate Old Bill Stone, the locomotive engineer, but just the same he fired the culprit. He couldn't have missed him, for he butted an entire department into an engine pit and chased every grimy one of them to the time-keeper's office for his money. No further investigation was necessary. Justice, so far as Marley was concerned, had been served. The affairs of the A. & P. Railroad couldn't be delayed while a busy superintendent turned sleuth. Besides, if the innocent suffered, it was, to quote Marley, "their own blasted fault." They knew about the dirty deal; could have prevented it.

Come to think of it, one man did escape. Ed Chatworthy, a lowly apprentice, cleared his grease-slickened skirts of blame by refusing to tell what he knew. A funny bird, Marley. He tried to bluff the kid into telling. Ed wouldn't be bluffed; nor would he lie. He looked the superintendent in the eye, said he knew something about it, and then asked Marley if he thought he was a snitch. By some process of reasoning known only to Daniel Marley, the kid's attitude exonerated him. Nevertheless, when the superintendent returned to his headquarters at Missouri Junction he went straightway to the roundhouse and with a single shout of warning butted Frink, foreman of the electrical gang, and his three men into a pit at the test loop. Neatly done, without hardly moving out of his tracks.

A peculiar duck, Marley; known wherever railroad construction jobs were being done as a fighter. Anything would rile him. As a self-appointed protector of old people, in particular veteran employees of his own railroad, it made him furious to think that a shop gang would stoop to humiliate Old Bill Stone on the last trip Bill ever would make.

WHAT if Old Bill had become something of a crab and a nuisance! Wouldn't he be seventy years old on November second? Hadn't he been sliding out of the gangways of loco-

ASIDE from aviation, no single development has done so much to advance safety and speed in travel as has the invention of automatic train control. Along 9,703 miles of track on forty-four railway lines in the United States, mechanical eyes and hands now supplement the vigilance of engineers, safeguarding speeding travelers against wreck and collision in fog or in the event of human failure. Mr. Creagan's entertaining story presents a vivid picture of the newest marvel of railway invention.

tives for fifty years? To pick on an old man like that!

The incident leading up to the affair had its beginning with Old Bill Stone bragging around the locker room that he would pull the mail on the morning of November first, that his would be the premier performance after the juice was turned into the new electrical system known as automatic train control.

Old-timers just winked and turned the conversation, but the gang around the test loop, where Frink and the others were working long hours to have things ready at the appointed time, found the old man's constant chatter annoying. He would stand in their way and harangue them about the proper manner of intricate installation, when all he knew about the new system of train control was that juice flowed along the track rails and a group of high-powered gadgets on the engine picked up the current and used it to apply the air brakes when a stop was necessary—that is, unless the engineer in the cab beat the automatic engineer to the brake valve. He'd potter around an engine that was being equipped with about twelve hundred dollars worth of ATC accessories, and test fragile tubes with a monkey wrench or mix valve oil with a special kind of liquid used in the axle drive.

You see, it was all so new and thrilling to Old Bill. He was to have a new toy after November first. For one trip only. He was to have an engine that couldn't collide with another engine or train; one that would automatically stop if something so much as stepped in its path. Ask Old Bill how it worked and he'd explain that the train ahead would short circuit the track and that would rob the thingumajig on the engine of its power. Without power the thingumajig just naturally fell and tripped something, and that something caused the air brakes to act. Then Old Bill would grin and say what fun it would be to run an engine like that after all the years he'd spent peering into blinding snowstorms and fogs to catch the gleam of roadside signals. All an old hoghead had to do now was to look at the little Christmas tree lights on the instrument board in front of him to find out whether the block was clear.

LONG before the night of the inauguration of the system the men at the test loop had grown weary of listening to Old Bill's talk of how he was prepared to repair any defect that might show up on his engine. He carried the proof with him. A pair of pliers, some copper wire, cotter keys, assorted nuts and screws, and a small bottle of milk-colored oil for the axle drive. Nor, to hear Old Bill tell it, was he worried about whatever trivial delays the new equipment might occasion. He could run it out; he could make up more time than any other hoghead running between Missouri Junction and Kansas City. A little delay or a big delay wouldn't bother him. He'd step out and haul the mail into Kansas City on time.

So they framed on Old Bill, to give him a chance to use his great fund of newly acquired electrical knowledge, and to find out how fast he could run.

Vague rumors had come to Marley that Old Bill was to receive



The superintendent stood hidden in the shadow of the roundhouse, in silent admiration of the throbbing locomotive. He watched Old Bill and his fireman as the two pottered around engine number 5019.

some kind of a raw deal. He stamped down to the roundhouse and bawled at the master mechanic. This was at eleven o'clock, an hour before the juice was to be turned into the new system, an hour and ten minutes before Old Bill was due to leave on the westbound mail. Naturally Marley's first thought was to swap engines, to give Old Bill one that hadn't been tampered with. Second thought informed him that he wanted to ride with Old Bill, and if any engine had been monkeyed with he wanted to ride that particular engine. Without making any change in the engine assignment he stamped back to the dispatcher's office.

MARLEY knew only one fear, which was more disturbing than the worries of an ordinary man. That fear was fog. Fog, the sinister, winding sheet that settled down without warning to wrap his railroad in a fold so clammy that no headlight ever devised could pierce it. All his railroad life, and there had been no other life for Marley, he had feared fogs. During his section-foreman days, not less than seven splendid handcars and more than a dozen laborers he had wrecked upon the pilots of speeding engines. And the train wrecks he had assisted in picking up, the frightful collisions in fogs, had stamped upon his mind a horror of the silent gray plague. As a roadmaster, and later as trainmaster, the sound of his telephone bell at night invariably called up the fear of a train wreck in a fog. When he moved up into the superintendent's chair the responsibility for an entire division served to increase his solicitude.

Marley had been around railroads long enough to know how futile it was to caution engineers about the hazards of high speed in fogs, when the damp, sticky stuff, clinging to signal lamps, dulled the red lens of danger until the brief glimpse from a speeding engine left a man wondering whether the light had been green or red. And hoping for the former. Marley knew engineers. Many of them were like Old Bill Stone, the hoghead who had pulled a special train out of St. Louis one night when the fog was so thick it seemed to push against damp faces. Marley hadn't forgotten that night, the agony of the six-hour ride while standing in the gangway beside Old Bill who

pulled the special for three hundred miles, most of the way through fog. The President of the United States occupied the car seventh from the engine, and the schedule was fast. Marley had had his instructions. He had passed them along to Old Bill. Kansas City on time! Regardless of fog! So Marley watched for the signals and a few of them he saw. At regular intervals he sang out to Bill Stone; "Nother green one, Bill!" Fifty miles an hour and fog most of the way.

That had been years before, when Marley was trainmaster. Fear of fog was still stamped on his soul. And it was that deadly fog, hanging along the river bottoms traversed by his railroad, that had brought the safety device known as automatic train control. In a few minutes the juice would be turned into the system and the dangers from fogs and blinding snows would be gone forever.

For twelve months Marley had looked forward to this night as the night of his emancipation. It was to have been a kind of gala night, with speech-making and hand-shaking. But all the feeling of celebration now left him in the worry over the rumor that the premier performance was headed toward failure, that a gang of heartless mechanics plotted to spoil Old Bill's last run.

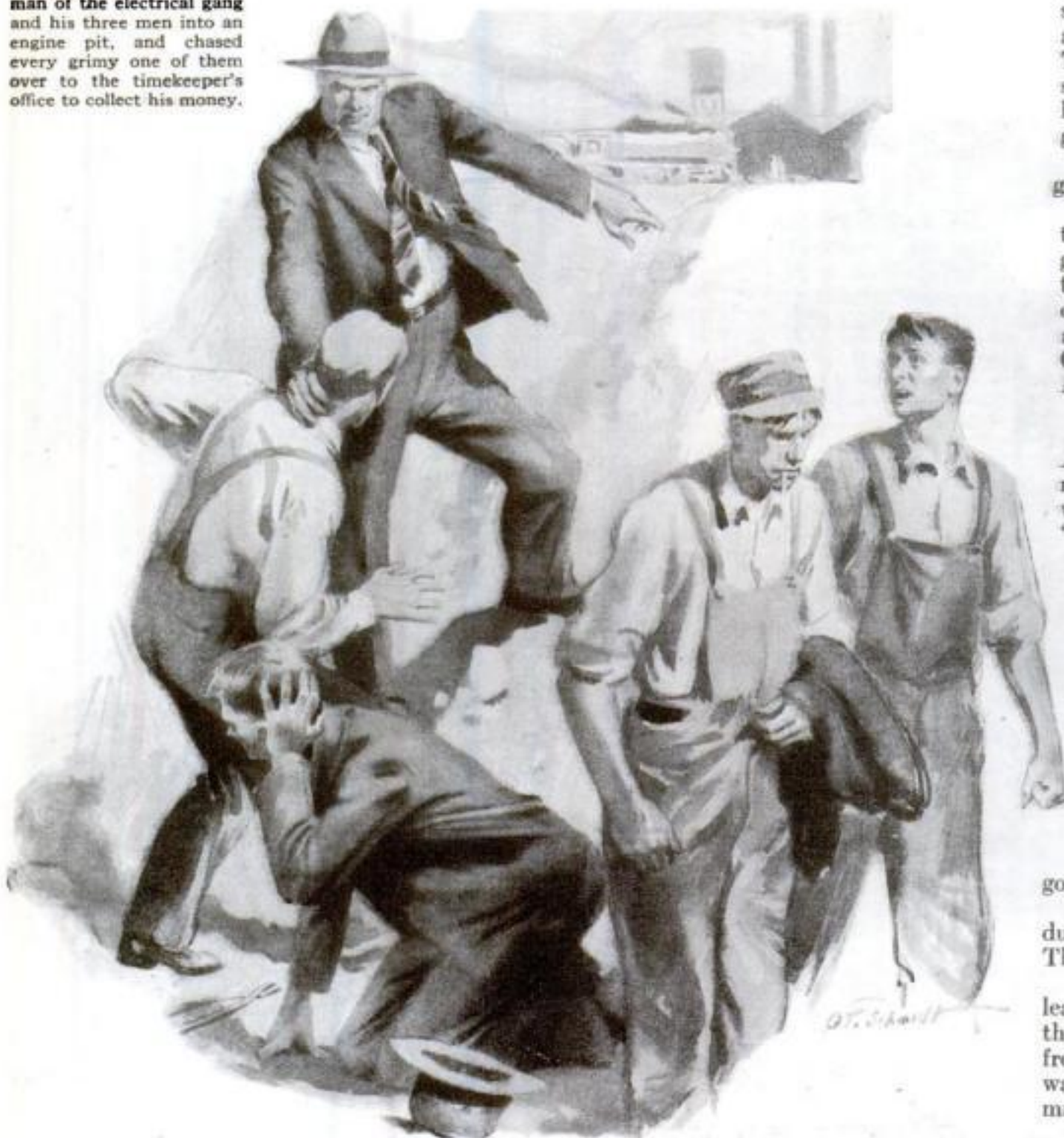
Marley's feet thumped to the floor with a clatter.

"How's the weather?" he questioned the dispatcher working west.

"Clear and calm except there's a little fog in the bottoms west of Little Blue."

THE superintendent grunted and strode out into the night. Across the black train yard he made his way to the roundhouse, where smoking torches told of engines being made ready. He saw Old Bill and his fireman pottering around engine 5019, but he did not join them. Instead, he stood in the shadow of the roundhouse in silent admiration of Bill's throbbing locomotive. A mighty machine in Marley's eyes; a long cylinderlike tender fitted with a kind of vestibule arrangement to an enormous boiler; four high drivers on each side connected with gray rods of tremendous thickness; a steam chest that appeared to contain all the power in the world; a locomotive of splendid lines

Marley butted the foreman of the electrical gang and his three men into an engine pit, and chased every grimy one of them over to the timekeeper's office to collect his money.



and apparent grace in spite of her bulk, a fit engine to haul the mail.

The 5019 was moving onto a short section of energized track known as the test loop. Old Bill sat at the throttle.

Marley saw a green light flash in the cab in front of the engineer.

"O. K.," Frink, the electrical expert, shouted. "Open the track switch."

The switch lever was turned. The green light blinked out and a red one appeared. Old Bill started the pump and the headlight generator; he tested the gauges for proper pressure.

"**WORKIN'** O. K.," Frink announced. "All right, Bill, there's your little plaything. She's all yours now. Take her over to the station and haul the mail. Don't forget to keep your axle drive filled with valve oil," he finished with a loud laugh.

Marley grinned. For a moment his worries left him. He had seen the test made; the equipment was in working order. But then he saw Frink standing under an arc light watching the 5019 as she moved majestically away. The expression on the electrician's face quickly dispelled the notion of security.

"You can go home, Ed," he heard Frink call to his helper. "Wouldn't have kept you so long but I wanted you to see she tested O. K., in case any questions are asked."

Frink disappeared into the roundhouse. The helper started toward the locker room. Marley caught the young fellow at the door.

"Come with me, Ed," Marley touched his sleeve. "Fetch along your tools."

"Where we going, Mr. Marley?" Ed questioned.

"To K. C. on the 5019. She's goin' to haul the mail. A neat bit of overtime you can make. I'll fetch you back in my car in the mornin'."

The headlight of the train was showing east of town when Marley and the helper reached the depot. The long mail train rumbled to a stop and a car inspector uncoupled hose and signal lines between engine tender and mail car.

"Take 'er away!" he called as he grasped a pin lifter.

The incoming engine was shunted to a short track and the 5019, grand and handsome, backed out to take her place. The steel jaws of the automatic couplers meshed and closed with hardly a sound. Old Bill was handling the engine. An engineer, Old Bill.

A SWITCH engine shunted Marley's private car onto the rear of the mail train. Couplings were made and car inspectors gave "all right" signals with lamps held high above their heads.

The superintendent stood apart, observing the movement. The conductor came forward with a handful of yellow flimsies. Old Bill read his orders aloud to the conductor, the last set of orders he would receive. They compared watches.

"Well, Bill," the conductor glanced over his glasses at the engineer, "I suppose you've got the automatic control cut in?"

Old Bill snorted. Just like a conductor to ask a question like that. The automatic control cut itself in.

"You can go to bed as soon as we leave town," the conductor poked the engineer in the ribs. "If a freight train stalls and gets in our way, the automatic hoghead will make the usual rough stop."

The mail was ready to start when Marley and the helper swung up the

iron ladder into the gangway.

"How about a little ride, Bill?" Marley grinned.

"Fine. Glad to have you, boss," he piped. "Who's the boy? Ed, ain't it?"

"Yes, my electrical expert," Marley announced. "Not that Bill Stone needs any assistance when it comes to handlin' the new equipment."

"All aboard!"

Old Bill, after "notching up," pulled slowly and steadily upon the throttle. The first train to be operated under the protection of automatic train control slipped out of the station at Missouri Junction.

The line of the A. & P. Railroad from Missouri Junction to Independence includes many winding curves sandwiched in between long stretches of straight and almost level track. Westbound the grade is slightly ascending, enough to keep the fireman off the seatbox unless the engine is equipped with an automatic stoker.

MOTIONING Ed to the fireman's seat, Marley stood swaying in the gangway at the engineer's side. The deck of the big Pacific shuddered and thumped under his feet as milepost after milepost slipped by. The fireman swung his strong young body between the coal gate and fire box, to stoke a roaring furnace whose door swung open and shut in response to an automatic foot pedal. The engine throbbed and barked as she attacked a short hill. Old Bill wasn't "beating" the 5019, but he was using his throttle.

A single green light upon the instrument board in front of the engineer told Marley that the new automatic control was functioning properly; that the track ahead was clear.

It was then that Marley crossed the gangway and thumped down beside the helper.

Glancing at the engineer, he caught

(Continued on page 154)

They're Farming the Ocean Now



On a Newfoundland banks schooner. Squeezing eggs from cod-fish and fertilizing them. Later they will hatch out near shore.

Government Achieves Amazing Results Breeding and Raising Fish Just as Farmers Do Livestock

By BOYDEN SPARKES

THAT expanse of ocean you see from the deck of a liner is not the wet desert it seems, but a rich, rolling meadow, teeming with life. It is a meadow that covers more than three-fifths of the world, everywhere more than a thousand feet deep, with a green, energy-producing pasturage for uncounted forms of life.

Every day the newspapers print significant things which tell the well informed and imaginative reader that the day is coming nearer when man must extend his intelligence to reap a greater harvest of food from this infinitely greatest source of supply.

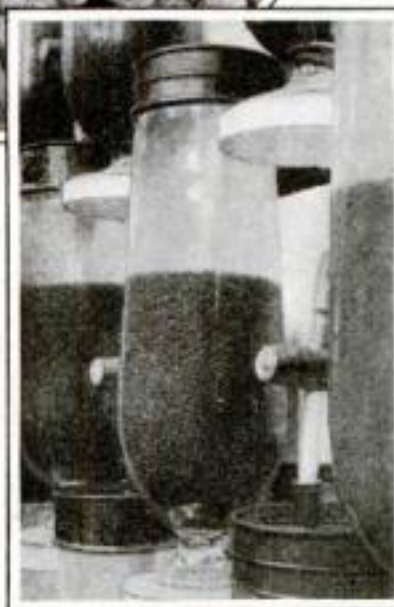
Recently a parade of wistful little slant-eyed children from New York's Chinatown marched to the City Hall to bring the attention of well-fed America to a famine on the other side of the world. Drought again and again has reduced millions of people in India and China to starvation, and there are scientists who believe this wretched state of affairs will not be confined to Asia fifty years from now.

"IN LESS than forty-five years," said Dr. William Crocker, director of the Boyce Thompson Institute for Plant Research, not long ago, "we may expect to have one hundred and ninety-five million people in the United States. When we have that many people we must



A highly magnified view of tiny shad hatching from eggs fertilized by Bureau of Fisheries experts. The young fish are kept sheltered until large enough to shift for themselves and then freed.

Shad eggs being hatched in glass jars on an island in the Susquehanna River artificially built by dredges to provide a site in particularly favorable waters for a hatching station. The middle jar contains about 800,000 eggs.



produce 75% more food for them to eat."

Unless something is done by science before then to widen the margin of safety, a few bad crop years in succession might bring famine upon us.

But the ocean can save us, for in its depths is hidden a fecundity which will

some day place all men beyond the reach of want.

Already the start of ocean farming has been made. You may see it any day on the Newfoundland fishing Banks aboard the swift schooners that for generations have reaped a harvest of cod by ancient methods from the waters that cover that submerged plateau. Today the American government watches there to preserve fish "seed" from waste.

THE process is no more extraordinary than that of sprouting seeds and shielding delicate young plants in hot houses. The female cod lays her eggs at the surface, where they float about with only chance of coming in contact with the fertilizing milt discharged by the male cod. As if to make up for this negligent scheme of reproduction the female cod casts eggs in such numbers that

if all hatched and reached maturity the progeny would fill several schooners. But the baby cod, smaller than minnows, are so furiously hunted by other fish that only a small proportion live to the reproducing stage.

Nowadays men of the United States

Bureau of Fisheries seize the living cod as they are hauled aboard the schooners and expel their eggs, called roe, and their milt into wooden buckets, where the miracle of fertilization occurs. When the eggs reach hatching stations ashore they are distributed into tidal boxes in which salt water, by an ingenious arrangement of syphons, imitates the rise and fall of the tides. After the young fish have hatched and survived the first few days of existence, they are liberated by the billion to fend for themselves in that boundless pasture we call the ocean.

Similarly grotesquely flat flounders are hatched in glass jars and freed in the shallow waters of our coast. Millions of these reach maturity and then are caught, many to appear in restaurants as filet of sole.

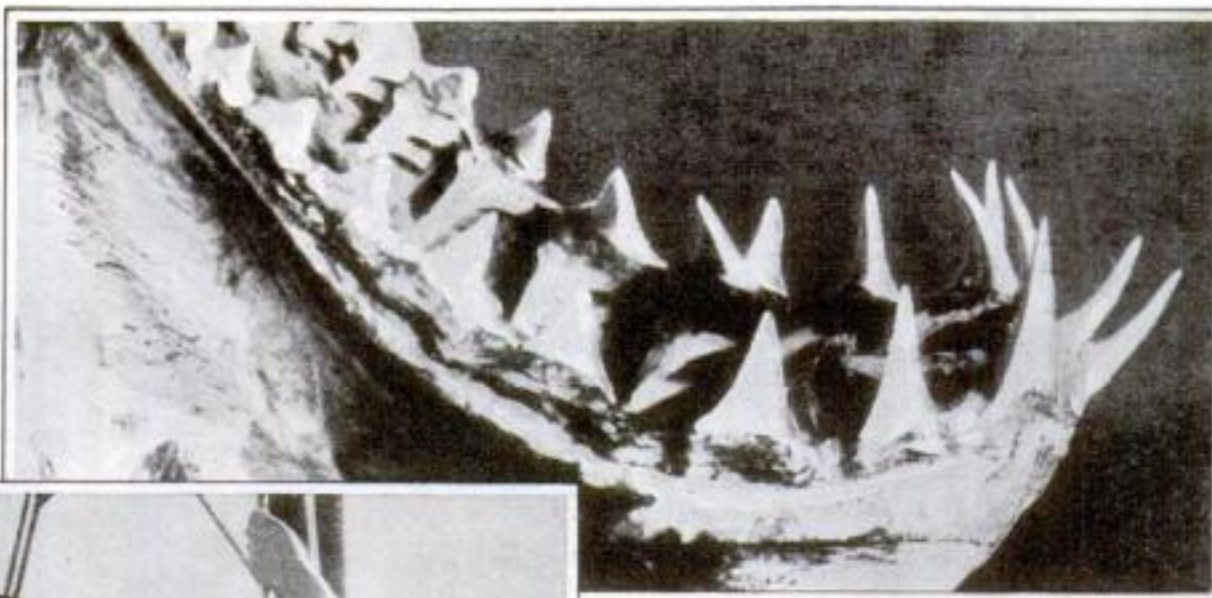
The annual crop of shad has long been a product of ocean farming mainly dependent upon planting much like planting corn. In the Susquehanna River an artificial island has been raised by dredges to provide a suitable hatching station.

EACH year the coastal streams are sown with baby fish, called "fry," that have been transported there in jars. But this method seems to have been adopted too late to preserve the species, for each year sees a lessening of the supply of this desirable fish.

Up on Alaska rivers salmon canners were becoming so efficient in seining out the fish on their way from the sea to the spawning beds, that this species, too, faced extermination. Today, thanks to the Fisheries Bureaus' hatching operations, the salmon seem as plentiful as ever.

Even lobsters are now hatched on shore, reared to a walking stage in submerged canvas boxes and then released into the sea. Horizontal propellers are kept revolving in their nurseries, lest they crowd together and eat one another. The method is, on the whole, expensive and better ways are being sought.

Another phase of ocean farming is being undertaken to increase the annual supply



Lower jaw of a tiger shark, showing terrible incurving teeth and the battery of reserve teeth that replace lost or broken ones.



An Australian shark fishing boat hauling up a tiger shark with a derrick. In this new industry the shark skins make splendid and beautiful leather and the fish also yield a valuable oil.

of blue crabs, which inhabit the arms of the sea threaded into our coast line. Here, too, the canning industry was responsible for the shortage. There is no egg problem in this, for the average female crab is burdened on her underside with as many as 2,500,000 eggs. Clams, oysters and sponges as well are being planted along our coast—yet the government scientists realize that they have barely scratched the possibilities of scientific ocean farming even with all these activities.

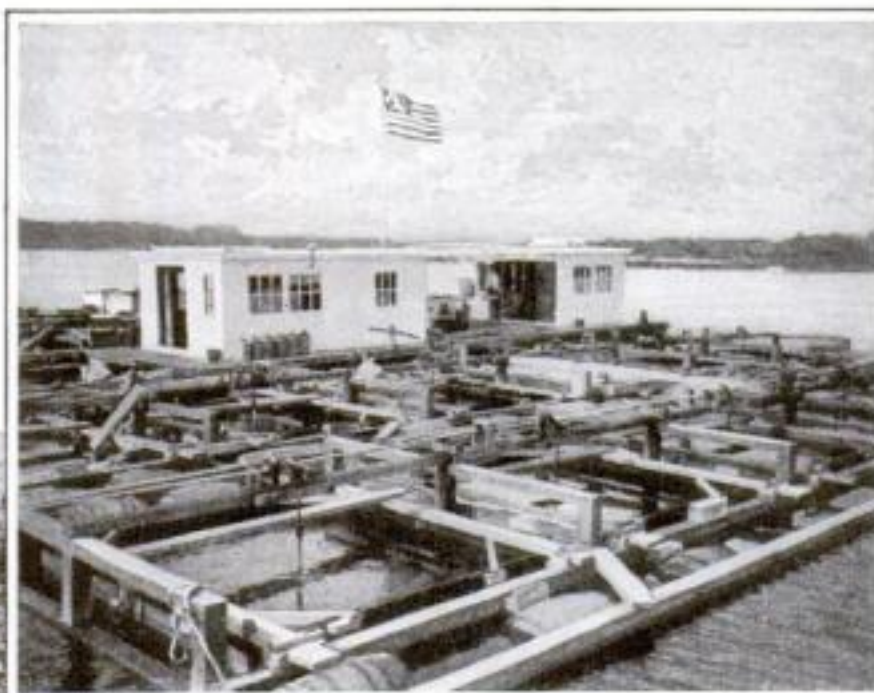
Attempts to increase the knowledge of these possibilities are being made today by a number of oceanographic expeditions. One of the most comprehensive recent surveys was a reconnaissance of the Gulf of Mexico, Caribbean Sea region, and neighboring parts of the Atlantic and the Pacific around the Galapagos Islands.

SUCH explorations are headed by men who are in a way the Columbuses, Coronados and Balboas of the present, but they are more in the nature of prospectors. They are naturalists and their work has been conducted on a scientific basis for less than one hundred years.

The greatest has been Sir John Murray, head of the British Challenger expedition. After him came the American Professor Agassiz, who made millions out of the Calumet and Hecla copper deposits before he could indulge his fancy to go to sea for new scientific knowledge as less ambitious men go for fish. The late Prince of Monaco was another great oceanographer and Scripps, the newspaper publisher, died at sea aboard the laboratory yacht on which he had spent years of his life and a generous share of his fortune.

Such expeditions are being financed today largely by governments. They are gathering a library of facts that will be invaluable when we really begin to farm the ocean in a systematic manner.

Paleontologists *(Continued on page 164)*



A lobster nursery—an arrangement of submerged boxes in which horizontal propellers turn to keep the lobsters apart and prevent their eating each other.



Salmon swimming by hundreds of thousands up an Alaskan river to the spawning grounds. So many were seined that the Government had to aid in reproduction to stay extinction.

What Is an Invention Anyway?

Mysteries of the Patent Office Explained—Why Many a Valuable Idea Cannot Be Protected and How Ignorance May Cost Fortune

By

P. A. CARMICHAEL

MILES from a garage on a little traveled road with a flat tire. Miles, also, from the nearest filling station. What was he to do?

He had tire patches and cement, but what good were they without a pump? Presently a farm boy came along who carried a little pump to rent for fifteen cents. The problem was solved, and the experience had put an idea in the motorist's head. Why shouldn't a pump, of suitable size and attachment, be fastened to the valve of a tire itself? He began to think more seriously about it and in time contrived a short, stocky pump which fitted on the rim, had a spring on the piston rod to facilitate its operation, and was worked with one hand. It would put twenty-five pounds of air in a tire without exhausting the pumper.

Visions of riches from his invention crowded his mind. He sent his design off to the U. S. Patent Office, with a request for a patent on it. Anxiously he waited. In time word came that he had not complied with the requirements for applications for patents. His hopes sank. Still, the patent had not been refused; perhaps he had better see a lawyer.

SO HE did, and found that applying for a patent is a legal proceeding involving considerable technique. In the first place, he must pay the Government a fee of \$20, and, in certain circumstances, later to be described, more. He must submit a formal document requesting a patent, describing the invention and distinctly claiming the features of it which were new, accompanied by drawings conforming to specific requirements of the

His invention may be useful, but it's patentable only if new, and perhaps the man at the bottom of the page originated it.

Patent Office. And, finally, the whole must be accompanied by a sworn statement from the inventor saying, among other things, that he had not publicly used his invention, nor offered it for sale, more than two years before.

It will repay us to look a little more closely into the foregoing requirements. To begin with, the application receives a Patent Office serial number and a filing date and a certificate of filing goes to the applicant. The application goes to the proper one of some fifty-five examining divisions, which ordinarily takes it up in the order in which it was filed. However, some applications receive preference, as for example, those for inventions which are judged to be of peculiar importance to some branch of the public service.

THE procedure in the examining division is by far the most important, since it is this that determines the intrinsic patentability of an invention. Unless the application clearly describes the invention and specifically sets forth the claims for it, the examiners may be left in doubt and so may reject it.

The invention is examined as against, among other things, what is termed prior art; that is, as against existing objects of its class or kind. If it was in use, whether in the hands of the inventor or of someone else, or if it was published—by description, picture, or otherwise—more than two years before the date of application, then it is unpatentable.

Obviously, the patent office cannot always know of these prior instances, and hence they are often brought forward in subsequent legal proceedings to invalidate granted patents. Claims that are too broad are occasionally allowed to inventions and cannot be upheld when challenged by previous inventors. There is one patent for a calculating machine that

makes 797 claims—so many that it might seem nothing was left for any other inventor of these instruments to patent!

Fifty to 200 claims are frequently allowed; but the greater the number, the greater the risk of challenge, as is shown in a new and revised edition of *Patent Essentials*, by John F. Robb, a book dealing extensively with inventions and the process of obtaining patents. It is published by the Funk and Wagnalls Company of New York.

THERE is one check against the endless piling up of claims for inventions—a government charge of \$1 for each claim made over twenty, which the \$20 flat fee allows the inventor to make.

Of course, the greater the number of claims allowed, the greater is the monopoly and protection for the inventor.

If an application for a patent survives the tests in the Examining Division—if it is in proper form, if it makes valid claims and if it is not faulty otherwise—then it passes on to the Issue Division, which issues another certificate and another charge equal to the amount paid at first is assessed. If this second fee is not paid within six months, the inventor or anyone to whom he may have assigned his invention may within a year from allowance of the first application renew his request for a patent without the formality of filing the same papers over again. In the meantime, anybody is at liberty to use the invented article without liability. After the period of one year, still another application can be made, but this must be a completely new one, as if none had ever been filed.

When the last fee has been duly paid, Letters Patent are issued on the fourth Tuesday after the first Thursday on or following the date of payment. They are issued to the inventor's attorney, if he has one, unless the attorney directs otherwise. The attorney has a lien on the patent if his fees are not paid.

We will now (Continued on page 170)



Not so dumb as many of us think he was. His ideas prevent many a man from getting a patent on a "new" invention.

SWINDLERS are finding radio, mysterious to most people, a fertile field. Thousands of radio listeners have been misled in the purchase of buried antennas purporting to prevent static, bring in more distant stations, and get rid of interference.

The Popular Science Institute of Standards has carefully and repeatedly tested various types of buried antennas. Without a single exception, they were found to be absolutely worthless. None was even as good as the average indoor antenna.

Of course, a buried antenna will reduce static, but unfortunately it will reduce the strength of the reception even more than it does the static. Exactly the same results can be obtained by snipping off a large portion of your regular antenna with a wire cutter.

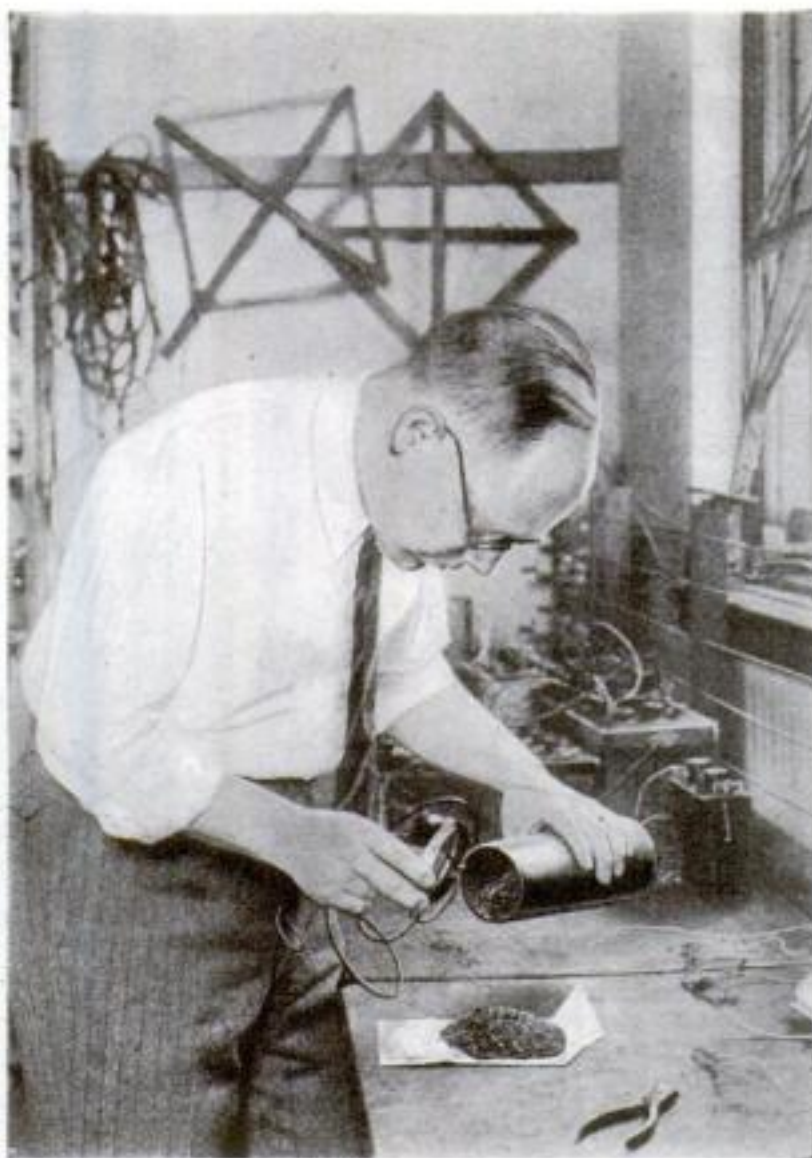
Several types of these buried antennas are being sold. The purchaser is given an instruction sheet that tells him to dig a hole and bury the can that accomplishes the alleged marvelous result, placing it a specified distance under the surface. The procedure is outlined in great detail although most of the details actually are meaningless and are used only to make the instructions sound important.

Claims made for the devices are scientifically absurd. They seem to be limited only by the credulity of the victim purchasing the device.

Advertisements of these devices are published in some of the most widely known periodicals in the country. POPULAR SCIENCE MONTHLY, however, basing its action on the reports from our laboratories, has refused to accept them. Once a reader answers one of these advertisements, he receives a series of sales letters. The first expands at great length on the results claimed to be obtainable with the particular device. Prices quoted are usually in the neighborhood of twelve dollars.

IF THE inquirer fails to respond, another letter is sent further extolling the device and offering it at a bargain price. Then, with failure to purchase, follows letter after letter, each more insistent than the last. Lower and lower prices are quoted until at last the device is offered for about three dollars, at which price the manufacturer can still make a fat profit.

A typical buried antenna was being



A typical "static eliminator," a can full of ground charcoal with twenty feet of enameled wire attached.

carbon or salt is to attract moisture and so make the ground connection more effective. But a ten-cent sack of salt certainly should not cost ten dollars! And certainly a ground connection is worth no such price.

Not all of the so-called buried antennas are merely ground connections. Some of them are made up of a can containing a small coil of rubber or lead-sheathed cable. They are as effective in bringing in the broadcasting as fifty cents worth of rubber insulated wire strung along the ground. In other words, they accomplish no worth while results whatever.

THE foremost radio engineers, such as Marconi, Armstrong, and Fessenden and also those of the United States Bureau of Standards, freely admit that there is no known way to eliminate static in the reception of broadcasting. And furthermore, most of the experts have little hope that static ever will be eliminated. In fact, the only possibility appears to be in making the broadcasting stations so powerful that the ratio of signal strength to static will be improved.

You know how little static bothers the reception of a powerful local station. You have to turn the volume down to a low point to keep the local stations from blasting your loudspeaker, and under such conditions the set is so insensitive that the static is not heard at all. Of course, there may be objections to super-power broadcasting stations, but such stations are, apparently, the only logical answer to the question of static elimination.

The actual number of feet of wire in an antenna is of no importance. What counts is how much area is covered by the wire and how high the wire is above the level of the ground.

YOU could, for instance, take a hundred feet of antenna wire and string it up in a single piece one hundred feet long and thirty or forty feet from the ground. Such an antenna plus a good ground connection would give excellent results in most localities. Now if you were to take that same amount of wire and cut it into two pieces and string them parallel, a couple of feet apart at the same height, you still would have an effective antenna. It would not, however, be as good as the one-hundred-foot one and, in fact, it would be practically no more effective (Continued on page 157)

Institute Exposes New Radio Gyps

BY ALEXANDER SENAUCHE



examined at the Institute when the photograph on this page was taken. It consisted of a small can made of thin copper and filled with ground charcoal. To a point just inside the upper edge was soldered the end of a twenty-foot length of ordinary enameled wire. A cheap tin cover completed the outfit. A tinsmith would be glad to make such a device for a dollar and a half.

This piece of apparatus is nothing more nor less than a ground connection, not one whit better than an ordinary length of pipe driven into the ground.

And if you want to find out what such a device will do for you in the way of improving reception, just disconnect your antenna lead-in wire and connect your ground wire to the antenna binding post of the set. You probably won't get any static, but you won't get much broadcasting either.

Other varieties of buried antennas sold at fancy prices are filled with different kinds of salt. The idea of the ground

Shall I Buy or Build a Radio?

The Answer Depends on You, But Here Are the Facts to Guide You

By ALFRED P. LANE



"**W**ould you advise me to build a radio receiver or to buy a regular factory-built set?"

To that question, asked us many times daily, there can be no definite answer. It depends altogether on the individual. Some men would never consider building their own receivers. Others take no interest in a set unless it is a product of their own handiwork.

As between building and buying, **POPULAR SCIENCE MONTHLY** does not champion either. Our function, as we understand it, is to assist you to purchase wisely if you want to buy a set and to help you solve your home construction problems if building appeals to you. And if you are undecided we want to help you by explaining the advantages and disadvantages of each course.

If results are the main consideration and if, in addition, you do not like to do mechanical jobs with your hands, don't attempt to build a radio receiver. Go to a reliable radio dealer, hear the various receivers demonstrated, and choose the model that gives the results you want at the price you can afford. Be sure, however, that it is of a type approved by the Popular Science Institute of Standards.

If, on the other hand, you take pleasure in making things with tools, you probably will want to build your own radio receiver.

Of course no one really builds a radio receiver these days. Present-day amateur

radio building is actually assembling factory-built parts.

The first consideration, whether you buy or assemble a set, is to decide what results are most important. Does the fascination of bringing in distant stations appeal to you most? Or do you put tone quality first?

The tendency today is to place tone quality above all else; and this seems logical enough, because the thrill of bringing in distant stations soon wears off whereas really fine music never loses its charm.

It is possible to get both good distance and fine tone in either a commercially built receiver or in a home-assembled one at a reasonably low cost provided you are satisfied with moderate volume. If, however, you insist on the limit of distance plus tremendous volume, with the best tone quality on local stations, there is no way either to buy or assemble a set without spending a considerable amount of money.

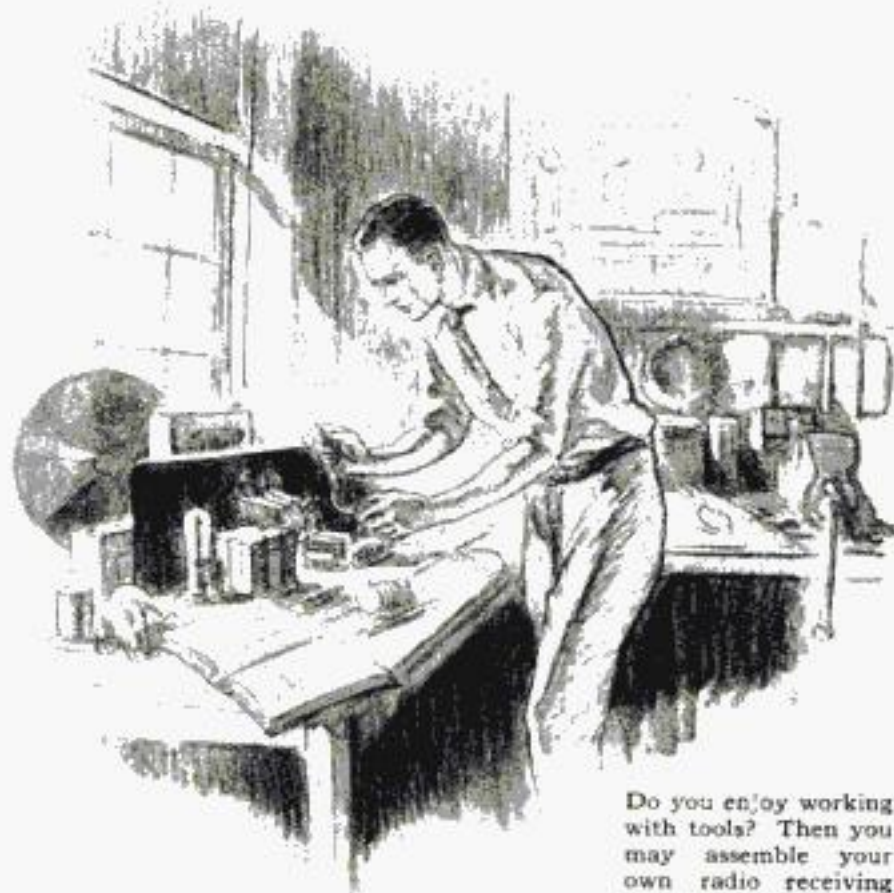
In both results and cost the simple, one-tube receiver is at the bottom of the list. The receiver using a single vacuum tube is so inexpensive to build that it is still very popular, especially with beginners. With such a set it is possible to get good headphone reception on the

local stations and if you have a good antenna and your location is favorable, you will bring in many stations hundreds of miles away. The chief disadvantage of the single tube receiver is that it is not particularly selective.

IN DISTRICTS where there are many powerful stations you will have considerable trouble in tuning-in one station without interference from those on neighboring waves.

The next logical step is to add an audio amplifier to a one-tube set. It will permit good loudspeaker reception on any station that can be heard clearly on the headphones with one tube.

A three-tube outfit of this type is the simplest radio



Do you enjoy working with tools? Then you may assemble your own radio receiving set with good results.

receiver that will give loudspeaker reception. Adding one more tube in a radio-frequency stage of amplification will greatly improve both the selectivity and the ability to tune-in distant stations. The resulting four-tube circuit is extremely popular with home radio assemblers. It is the most practical set for the man who desires to assemble a satisfactory receiver as economically as possible.

VERY few one, three and four-tube receivers are factory-built today because in commercial construction a five or six-tube set can be built almost as cheaply as one of fewer tubes.

There are, of course, kits covering the essential parts of the tuning circuit, leaving it optional with the purchaser to complete the receiver as he desires.

The question whether you want a battery-operated or full electric type radio receiver must be decided in favor of the battery-operated type if you have no 110-volt electric light current available.

If current is available and you expect to buy a factory-built receiver, we would suggest the full electric type. And this advice also applies to a home-assembled receiver if you are just taking up radio. In that case you can start fresh without having to bother with equipment already on hand to operate an older set.

Even if you are building a simple one-tube radio receiver it can be made full electric to the extent of eliminating the A-battery. By a careful choice of parts you can rebuild the one-tube set into a larger outfit.

Whether you buy complete or assemble for yourself, we stand ready to help you solve your problems. In writing for information or advice, be sure to give us as many particulars as possible about your problem. Address your letters: Radio Editor, **POPULAR SCIENCE MONTHLY**, 250 Fourth Avenue, New York City.



But if your fingers are all thumbs your radio problem is simply solved. See a reliable dealer and buy what you like.

Hints for the Beginner in Radio

Why Choke Coils Are Needed

A Loudspeaker Cord That You Can Walk On—Adjusting the Voltage in Eliminators—A Good Method of Sharp Tuning

YOU can operate a loudspeaker at a point some distance away from the radio receiver without in any way impairing the results. In fact, the only problem is that of running the necessary wire. If the radio receiver and the loudspeaker are on the same side but at different ends of the same room, the wire can, of course, be run along the baseboard. But frequently it is necessary to run the wire across the floor under the rugs. Ordinary loudspeaker extension cord is not suitable for this purpose as the round cable raises a ridge in the rug that wears quite rapidly.

The novel loudspeaker extension cord shown in Fig. 2 eliminates this trouble. The two wires are embedded in a flat strip of rubber with feathered edges. It lies flat on the floor and makes no appreciable ridge in the rug.

What Choke Coils Do

EARLY types of radio receivers rarely included any choke coils in their construction. Modern sets, both factory-built and home-assembled, make considerable use of them.

The choke coil is not a new piece of apparatus. It was well known long before broadcasting, but the importance of the choke coil in forcing the electric currents in the radio receiver to keep to certain definite paths was not fully appreciated until tone quality came to be so all-important.

Two kinds of choke coils are used in a radio receiver because there are two kinds of electric current circulating in its wiring. In the radio-frequency end of the receiver, that is, from the antenna to the detector tube, the currents are oscillating at tremendously high frequencies. The currents circulating in the wiring between the detector tube and the loudspeaker are at much lower frequencies, so low, in fact,



Fig. 1. A high resistance unit consisting of several individual resistances that are connected in series and cannot be adjusted beyond limits of safety.



A B C's of Radio

RESISTANCE units are commonly rated by the number of watts of current they will safely dissipate in the form of heat. While this method of rating allows you to figure the safe current-carrying capacity of the resistance, it would be better for the radio amateur if the manufacturers would specify the current-carrying capacity in milliamperes. When the rating is given only in watts, divide the number of watts by the rated resistance and the result will be the square of the current the resistance will safely carry. Determine the square root of this figure and you have the current in amperes.

that they become sound when translated into air vibrations.

A relatively small choke coil will serve to force radio-frequency current in the proper path. This path must be provided in the form of a by-pass condenser. If the by-pass condenser (another name for a plain condenser) is not connected in the circuit the current will flow right through the choke coil but with much reduced strength. Remember this when you are building or testing a radio receiver. If the wire to a choke coil is broken, the current can't flow and if the wire to its accompanying by-pass condenser is disconnected the current won't flow except very weakly.

Relatively large choke coils are needed to cut off currents at audible frequencies. Radio-frequency choke coils usually are made with no cores, whereas audio choke coils have heavy laminated iron cores.

Adjustable High Resistance

IN BUILDING a B-eliminator or a power amplifier unit combined with a B-eliminator, there are undoubted advantages in having adjustable resistances so that the various voltages can be changed to suit conditions. However, the difficulty in most circuits providing for adjustable voltages is that there is nothing

to prevent the adjustment being carried too far. If, for instance, the proper C bias voltage should be forty volts and you accidentally operated the outfit with the voltage much too low, the power tube would be ruined in a short time. Similarly, if you set the B voltage for the first audio stage a hundred volts or more high, you might blow the filter condensers and you would be sure to shorten the life of the tube.

Unless you can make sure that the adjustments are within a safe range it is much better to rely on fixed resistances. However, it is possible to obtain voltage adjustment within safe limits by the use of the new unit shown in Fig. 1. This unit consists of a series of individually adjustable resistances connected in series to make up the total resistance required. Each of these individual resistances is so devised that the voltage it controls can be shifted only within safe limits.

How to Tune Sharply

RADIO fans who are interested in getting the last possible fraction of strength out of a distant signal may well take a tip from the expert photographer.

When the photographer focuses the image on the ground glass of his camera he rotates the adjusting knob back and forth so that the lens moves first beyond and inside the point where the picture is sharp. By making the motion less and less each time he finally allows the knob to remain at the point of exact focus. In tuning your radio receiver, move the adjustment back and forth in the same way if you want precise tuning. Then when you have located the point where the broadcasting is as loud as possible, read the dial very carefully and note the figure on your record of stations. The next time you want to listen to that particular station, you can tune it at once.



Fig. 2. A flat loudspeaker extension cord runs under a rug without making an unsightly and awkward ridge. Its wires are embedded in rubber.

Radio Hails the Dynamic Speaker

Powerful Electromagnet Operating Directly on a Moving Coil Reproduces Music with Greatly Increased Fidelity

By JOHN CARR

ANOTHER revolutionary change in radio loudspeakers is impending.

The cone type speaker rapidly drove the ordinary horn type into oblivion. Now the still newer dynamic cone threatens to drive out the cone.

The cone replaced the horn because it reproduced music more faithfully. It brought in low notes that were completely missing on the ordinary horn and it did not overemphasize certain tones at the expense of others—a common fault of all small horn speakers.

And if the dynamic cone in turn vanquishes the ordinary cone, tone quality plus great volume will be the deciding factor.

Curiously enough, the dynamic cone speaker is not really new. In fact, the unit that drives it is one of the oldest forms of loudspeaker units; thousands of them were sold in the early days of broadcasting. But the possibilities of the dynamic speaker units were not realized at that time; first, because the horns to which they were attached caused severe distortion, and, second, because the radio sets of that day distorted so badly that really good tone quality was an impossibility anyway.

The theory of the operation of the ordinary cone type loudspeaker unit was explained in an article in *POPULAR SCIENCE MONTHLY* for August. As shown in that article, the pulsating electric waves representing the sounds being produced in the broadcasting station are translated into actual sound waves by the variation in the magnetic pull of a powerful permanent magnet on a small iron armature that is connected by means of a stiff wire to the apex of the cone.

THE dynamic speaker unit also operates by electromagnetic attraction. But instead of utilizing the pull of a permanent magnet on a piece of iron, the dynamic speaker uses a very powerful electromagnet which acts directly on a coil of wire. The coil is attracted to the magnet when electric current flows through the winding, although the attraction is not nearly so powerful as if the coil had an iron core.

This weaker pull explains the need for an electromagnet instead of a permanent magnet. Permanent magnets are limited in their pull, whereas the pull, of an electromagnet is limited only by the amount of electric power you use. The extra pull of the electromagnet makes up for the weaker pull of the small coil.

The diagram in Fig. 1 shows the construction of the dynamic type cone loud-

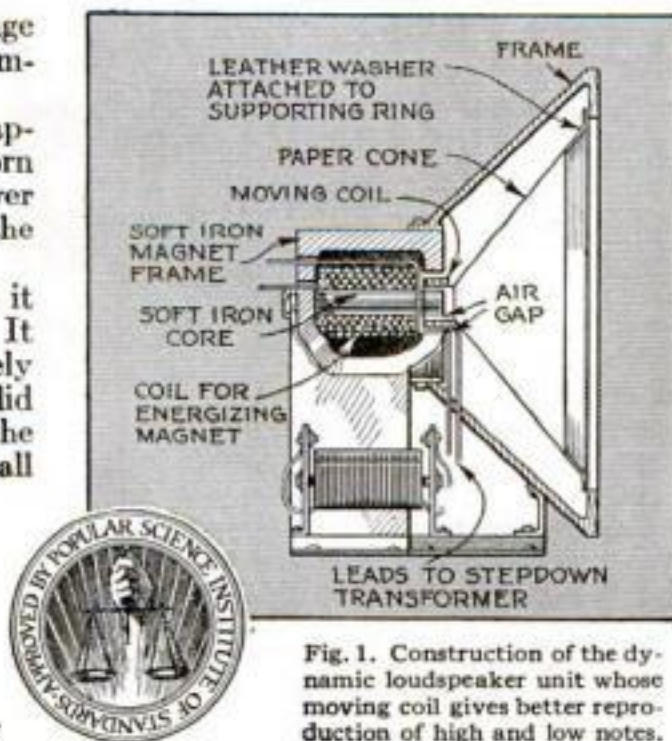


Fig. 1. Construction of the dynamic loudspeaker unit whose moving coil gives better reproduction of high and low notes.

speaker. Note how the frame is arranged so that the large coil of wire produces an intense magnetic field between the center pole and the frame close to it.

The small movable coil consists of just a few turns of wire and is fastened directly to the apex of the cone. This small coil could, of course, be connected directly in the plate circuit of the power amplifying tube, but it would have such a low impedance that the music or speech would be very weak. And since it would be difficult if not practically impossible to make a really light coil with a large number of turns, the problem is solved by feeding the power from the amplifying

tube through a step-down transformer which may have a step-down ratio of twenty or more to one.

Now why should a dynamic loudspeaker unit made as described be any better than the ordinary balanced armature type of unit that is so popular? There are at least three reasons.

The first is that the movable coil and the small cone attached to it can be made extremely light so as to vibrate easily at the higher audio frequencies and reproduce the high notes and overtones with maximum fidelity.

Second, the movable coil can move a considerable distance both in and out without changing the relative magnetic effect of the electromagnet on the coil. This means that on deep notes of the organ the coil can move back and forth through the long vibrations required for the low tones. In the iron armature type of speaker unit the magnetic effect becomes much more pronounced as the armature approaches the pole piece of the magnet and distortion results.

THIRD, the electromagnet exerts no pull at all on the movable coil except when the signal currents are flowing through it. That means that there is no need for stiff, heavy springs to hold the coil in a definite relation to the electromagnet as is necessary with the iron armature type.

For these reasons the dynamic type speaker unit is able to reproduce a wider range of musical frequencies than the balanced armature type; and in addition, because of the great freedom of movement permitted the coil, it can reproduce music or speech at tremendous volume without distortion.

But while the dynamic type cone will reproduce the lowest notes, it cannot put them on the air effectively without the aid of a baffle board. When the photograph on this page was taken experiments were being conducted by the Popular Science Institute of Standards to determine the effect of different sized baffle boards on a standard type of dynamic loudspeaker.

The theory of the baffle board is relatively simple. When the cone vibrates at any frequency, it sends out air waves from both front and back. These air waves are exactly opposite in phase; in other words, while the cone is producing a compression wave from its front surface, it is necessarily *(Continued on page 163)*

The names of the winners of the "What Would You Do If You Were Czar of Radio?" contest announced in *POPULAR SCIENCE MONTHLY* for July appear on page 157.



Testing baffle boards of various sizes on a dynamic speaker in Popular Science Institute of Standards. The boards improve the sound.

A Play That Made Football Over

Famous Gridiron Star Explains How the Forward Pass Has Given to the Game a New Strategy and Greater Thrills

By EDWIN B. DOOLEY

The author of this article, a star developed by Jesse Hawley, famous Dartmouth coach, is a maker of football history and won the honor of All-America quarterback for 1924.

THE whistle sounded for the second half with Cornell and Dartmouth deadlocked 14 to 14. Fifty thousand fans had howled themselves into football hysteria a few minutes earlier as Cornell had battered its way by sheer power to two touchdowns. Molinet, the Cuban fullback, had smashed our line to pieces with his catapult plunges.

Our backs were against the wall. We received the kick-off and, knowing Cornell's amazing strength, held the ball as long as we could before kicking. Once again the big Red machine started its inexorable drive down the field. A plunge here, a thrust there, drove us back again and again.

Now a Cornell back fumbled and we got the ball. Here was our chance. We would make the most of it. Against that Juggernaut there was but one play to make—a pass!

Quickly I scanned the Cornell defense. Between the backs who were reinforcing the line and those guarding against long runs and forward passes was an unusually large gap. A pass in that neglected territory was the play to call. I barked the signal. Bob Hall, our halfback, took the ball on a pass from the center and ran a few steps to the right as though to slice off a tackle, then shot the ball whizzing into my outstretched hands.

CORNELL was caught napping. Not a man within

twenty feet of me, I was unhindered for a touchdown.

That play must have broken Cornell's heart. Our masters as they were at straight football, here was something they could not guard against—the pass. A few minutes later I shot the ball to Bjorkman and our best wingman tallied again, making our victory 28 to 14.

Without the forward pass on that unforgettable afternoon Cornell would have waded through us to brilliant victory at the Polo Grounds and we would not have made football history of 1924. For Gil Dobie's splendid running attack packed immeasurable power, and against Cornell's phenomenal off-tackle play nothing but the forward pass could have saved us.

That pass is to football what aviation is to warfare. The opponents never know just when it will strike, and if they

sense its coming, they cannot tell just where. It may go spiraling over their heads, it may shoot past them with bulletlike speed, it may sail far down the field into the arms of a speedy end, or be lofted over the line to some elusive halfback who has penetrated the defense unseen.

THE very uncertainty is baffling. Think of that critical situation last year, when, with time fast ebbing, the Princeton Tiger seemed the victor over Yale. It was then that quick witted Johnny Hoben zipped a beautiful forward pass and Dwight Fishwick dashed to a touchdown. A daring play at a critical moment, but on it hung victory.

Each gridiron season witnesses dozens of such plays. Last year it gave victories to Ohio State over Chicago, to Virginia over North Carolina, to the Navy over Pennsylvania. Santa Clara beat Stanford when Charlie Falk shot a twenty-yard pass to Kenneth McCormick.

Illinois beat Northwestern by Stuessy's pass to Jolley of only ten yards. And Michigan State beat Kalamazoo on a pass of barely five yards. Nothing else could have gained the necessary yardage, for when a team gets down near its goal line, it fights with increased stubbornness.

But there is no axiom that whenever a team is in need of a touchdown it should pass. Quite the contrary. Hundreds of forward passes have proved boomerangs of defeat.

I remember one a few years ago that cost Dartmouth a game. We were within striking distance of the Yale goal, and the Eli line was fighting for all it was worth. The defensive Eli backs were playing wide and there was a beautiful opportunity for a short swift pass down the center of the field. As I had been throwing the passes, I thought it would be more deceptive to have one of the halfbacks throw this one. But the halfback misunderstood the signal,



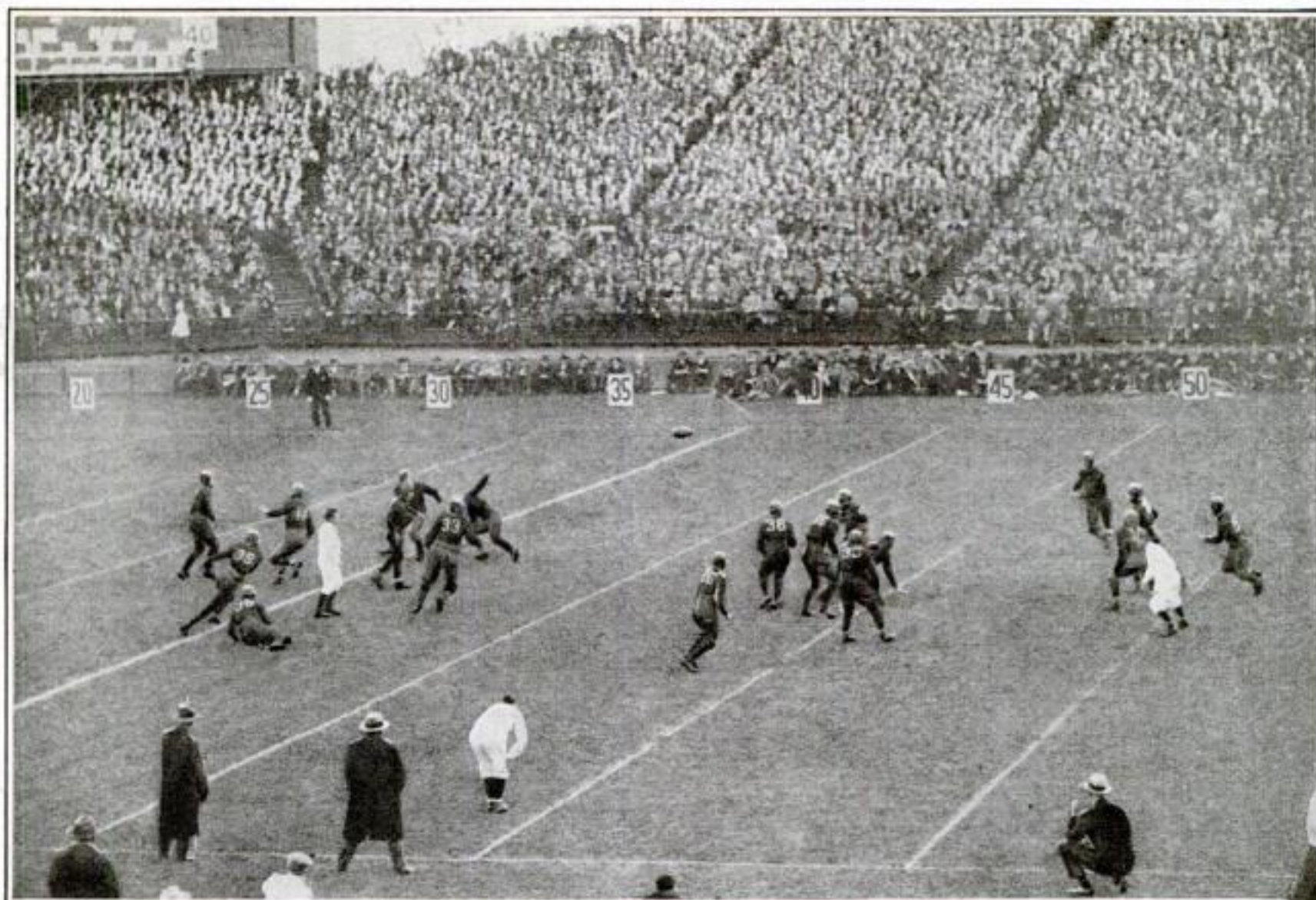
The sanitary water wagon that Leland Stanford, Jr., University provides for its players and for visiting teams.



Coaching Staff of the Washington University team study various plays scientifically with a machine whose units represent players. It is operated here by Head Coach Bagshaw.



Coach Heighes, of De Pauw University (rear), receiving a backhand lateral pass from Joe Pipal, coach at Occidental College, Calif., who devised this new pass.



Walsh of Notre Dame, famous for its forward passing, throwing a pass before 76,000 rooters in a game against the Navy. Notre Dame won in the 1927 contest by the score of nineteen to six.

and instead of throwing the ball to the unguarded area where the right end awaited it, he threw it towards the sideline where our substitute halfback had mistakenly run. The pass was intercepted by McGonnigle of Yale, who made a brilliant run to within the shadow of our own goal.

That change of fortune acted as an inspiration to the Yale team, and in a few minutes it swept through us to score the winning touchdown.

To the average football fan, the forward pass is one of the best thrills of watching a game. But he regards it as something of a hit and miss affair that a team resorts to occasionally, on a chance of gaining some "easy" yardage. As a matter of fact, it is the most scientific part of football. Not only does the throwing require skill and science, but the planning that precedes an aerial attack is purely a scientific procedure. That may sound a bit strange in view of

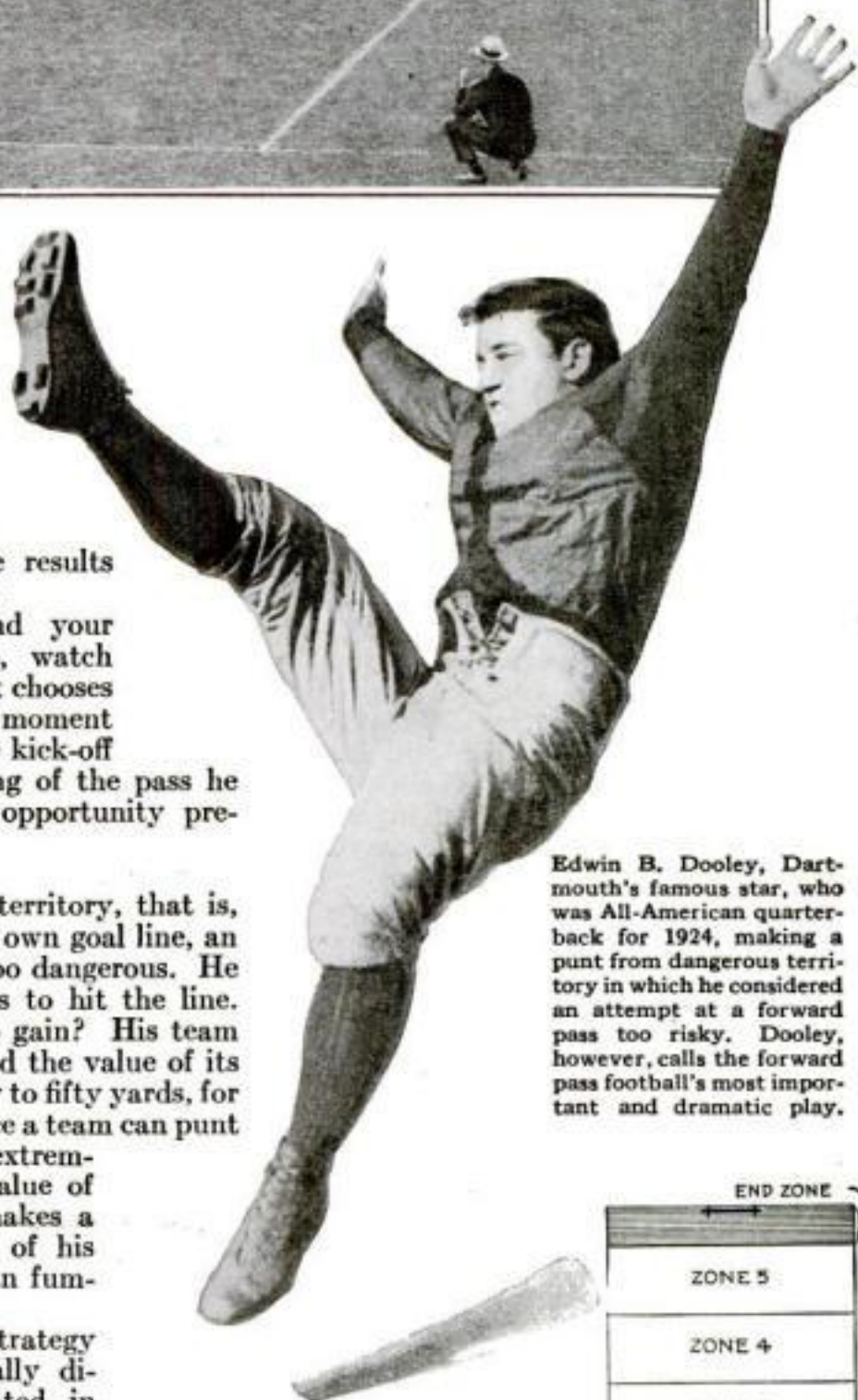
the reckless abandon with which the game seems to be played, but it is safe to say that virtually all of the passes I have mentioned were the results of scientific strategy.

When you attend your next football game, watch how the quarterback chooses his plays. From the moment his team catches the kick-off he will start thinking of the pass he will use when the opportunity presents itself.

IF HE is in deep territory, that is, back towards his own goal line, an attempt to pass is too dangerous. He can direct his backs to hit the line. What if they fail to gain? His team still has the ball, and the value of its possession is forty to fifty yards, for that is the distance a team can punt if driven to that extremity. It is the value of possession that makes a coach jump out of his shoes when a man fumbles the ball.

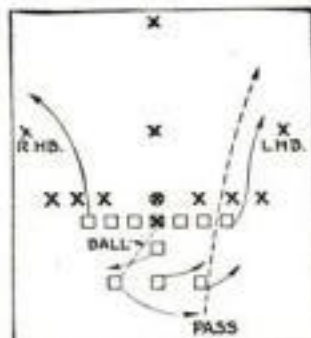
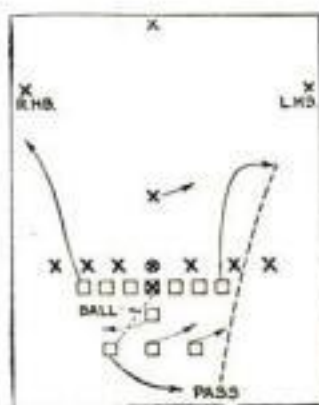
For football strategy the field is usually divided, as indicated in the accompanying diagram, into five zones of twenty yards, numbered from the team's own goal line. (Some coaches, however, use a three- or four-zone plan.)

Zone No. 1 is most dangerous for passing, but as a team goes beyond the middle of *(Continued on page 152)*



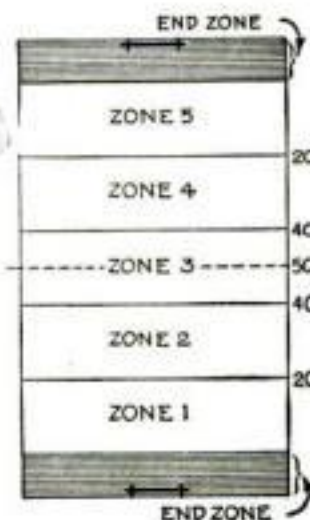
Edwin B. Dooley, Dartmouth's famous star, who was All-American quarterback for 1924, making a punt from dangerous territory in which he considered an attempt at a forward pass too risky. Dooley, however, calls the forward pass football's most important and dramatic play.

Right: This pass beyond the left halfback should make him move back on the next play in order to prevent its successful repetition.



Left: Having made the defending left halfback move back, the offensive team may now try a short pass as indicated here into unguarded territory or drive through the defending left tackle.

A good quarterback passes in Zone 1 only in an eleventh-hour effort to win. He passes with discretion in Zone 3 and at will in 4 and 5, where interception of ball is least damaging.



Making Things Fit *that* Don't Fit

Engineers Fight Against Odd Sizes in Hardware, Film, Masonry, Plumbing, China, and Even Bedsheets

By
HYATT E. GIBSON

A MAN yelled into the 'phone: "This is Fire Chief of Millville! Send help quick! Big fire getting away from us. For God's sake, send all you got!"

"Sure thing!" shouted back the fire-house official in the neighboring town of Orono. "Our engine and truck will be with you in twenty minutes. I've shot the alarm. The boys are a-running."

"Don't lose a second!" entreated Millville. "It's spreading down Main Street. If the lumber yard catches the whole town goes!"

"Cheer up. We'll burn up the road. Have a man with a red flag at the hydrant we'll hook up to."

"Orono is coming!" was the glad shout of panic-stricken citizens, and the sweating firemen toiled on with new hope.

At fifty miles an hour the engine of salvation roared into town, paused with a tremendous grinding of brakes at the red-flagged hydrant, and then went on to unroll hose. The citizens cheered, tears in their eyes.

BUT Orono might as well have stayed at home! Her powerful new engine did not throw a drop of water—the Orono hose coupling did not fit the Millville hydrant; there was a trifling difference in thread or size. Only a change in the wind's direction and a heavy rain saved Millville.

The foregoing incident is entirely imaginary, yet it might have taken place anywhere in the United States. As a matter of fact, Fall River, Mass., would have had almost an identical experience in its recent disastrous fire when apparatus was called from neighboring places but for the fact that its hydrants had been standardized a few weeks previously;

while in the Baltimore fire of some years ago, several near-by towns rushed their apparatus to aid the stricken city and were foiled by a lack of fit in hose and hydrants.

While the reader considers a possible moral to be drawn from such anecdotes,

"PUFFING BILLY," Stephenson's first locomotive, was tried out on the horse-car track of an English mine. The rails were 4 feet 8½ inches apart, so that is the standard gage for railways today the world over!

With no greater scientific basis, a hundred and one styles and sizes have grown up in other fields. In this article Mr. Gibson points out that half the productive energy of the nation is lost in making odd sizes and misfits. Then he describes the fascinating battle to eliminate this waste.

whether a concrete remedy or a general indictment of civilization's intelligence, I will present the case of John J. Smith, who planned a two weeks' vacation.

"I'll put in the first three days tinkering the house and patching the car," announced John J. to his wife. "I'll clean up all the odd jobs that have been waiting for half a year. Then we'll have ten or eleven days for a trip into the country."

"Will you please look after that vacuum cleaner attachment first?" requested Ella.

"Certainly. I'll get that in five minutes at the hardware store," and away he went.

"What model?" quoth the dealer. "Zip No. 2, eh? Out of date. Anyhow, I don't carry it and nobody else does in this burg that I know of. And we only sell attachments for our line."

"FOOLED on that cleaner, Ella," said John J. at home. "I'll have to write to the manufacturer. Now I'm going to pick up a faucet for the bathroom and a few doodads for the car."

The simple quest for a faucet that would fit consumed almost half a day, while that for the car doodads took two entire days, including time required to hear a dealer's eulogy on how practically everything in the automotive line was interchangeable. Of course, you could not expect this and that, you might find some articles at a hardware store and for others the best place for a quick find was an automobile junkyard. Curtains were made to order. A lot of parts were easy to substitute by making them smaller or larger, bushing, rethreading or whatnot.

"He's a dod-blasted prevaricator!" said John J. to his wife. "If I had a machine shop and a foundry, maybe yes. Take just this wrench business. I have sixty-two wrenches—count 'em—and not one that fits the bolts on my carburetor so I can take it off and clean it. Instead of three days I'm spending a week on these fool jobs. Half my vacation used up."

Everyone must sympathize with Mr. Smith, for we are all fellow sufferers amid the evils of odd sizes, unmatchable parts, fitless bolts and jiggers that don't jibe. It is a scandal that we have not revolted long ago against the mean dragon of wasteful diversity.

However—and thanks be—that dragon is on the run. The chase of him started several decades back, but has become



Everybody benefits because sensible standardization has made 342 out of 480 kinds of paint brushes "walk the plank" that leads to well deserved death in the ocean of extinction. We would all save money if more should go the same way.



The first shot "killed" 55 out of 66 kinds of paving brick; later 5 more succumbed. Then rough face, smooth face, and common brick were cut down from 34 to 44 needless varieties of each group to a satisfactory one.



The dragon of waste in odd sizes, unmatchable parts, and fitless attachments is gradually being killed by intelligent standardization; but the monster is far from being dead, for it still costs the United States some thirty billions of dollars—half of all it produces—every year.

keen and well organized since the World War, especially during the last five years. The leaders in this crusade are the United States Department of Commerce, the Chamber of Commerce of the United States, and the American Engineering Standards Committee. A great host of horsemen and footmen battle under their banners and raise cheers at gains expressed in the lopping off of two decimals and the abolition of nine half-sizes.

We have indeed a splendid army in the field. Yet it is a mistake to conclude that the enemy is practically licked. At this moment, despite all improvement, about half the productive energy of the United States is thrown away through lack of uniform and simple method. This means about thirty billion dollars wasted every year. It means that half our annual labor is a total loss. With a four-hour day and

standardization we could have as much wealth as our present eight-hour day produces. And that statement is not made by a wild Utopian or a naughty red. It comes from a sober body of engineers under the presidency of none other than Herbert Hoover, who resigned as Secretary of Commerce to be a candidate for the Presidency.

PROF. COLLINS P. BLISS, Director of Popular Science Institute of Standards and Associate Dean of the College of Engineering, New York University, is also a doughty warrior in the crusade against the dragon of waste, being a member of the American Engineering Standards Committee.

"The battle line," he told me, "has so many fronts and so many engagements are going on that it would take a book just to summarize the affair. A lot could

be written on the offensive against haphazard valves and fittings, which has taken four years to complete. Now all steam, water, gas, oil—in fact almost any kind of flowing matter—can be conveyed in systems whose parts are absolutely interchangeable. And when new or repair parts are ordered the user knows they will fit and conform to all requirements for strength and safety. In one month alone ten thousand copies of the printed standards in this line were ordered in various industries.

"Every householder can see the benefit of uniformity and simplicity in house plumbing. A committee is now being formed to standardize this field. Think what a satisfaction it will be to order a fixture and know that it will fit, with distances between holes for pipe connec-

tions and drains all the same, every detail bound to match. When your boy jumps on the wash basin to reach the ceiling and the basin cracks, the plumber around the corner will have a precise duplicate. You won't have to send to a distant city and meantime use the kitchen sink for a week.

"Standards for mechanical refrigerators of the home type are being studied, insuring a simpler, better, and more economical refrigerator within the near future. Everything will be considered from the kind and thickness of insulation to the size of box and the details of mechanism. You will know what you are getting for your money. This will extend nationally some of the benefits hitherto afforded to readers of this magazine through our own Institute of Standards laboratory. We will then have a less strenuous task in checking up different makes and will not find so many outfits of dubious quality. If you do not have a machine refrigerator and cling to the old style ice box, you may care to know that your interest is catered to in the national campaign: standard sizes of ice cakes in weights of 25, 50, 75, 100, and 150 pounds, along with specified dimensions, have been adopted this year.

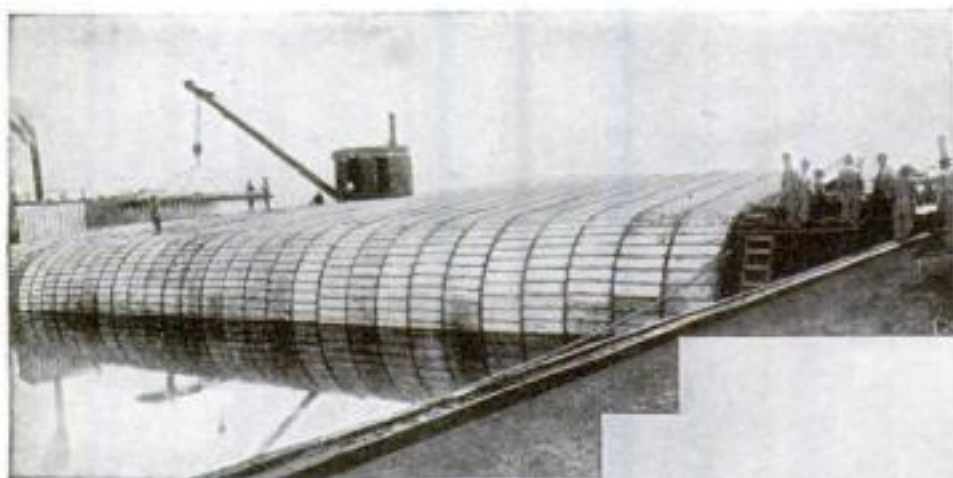
"**EVERYBODY** should become an enthusiastic supporter of the movement to simplify and unify. We are all concerned, whether we buy a pipe cleaner or a car, a bedsheet or a hack saw blade. The manufacturer is equally interested; for him it is costly to tie up capital in raw material, stock, space, and surplus repair parts, and to make a hundred complicated varieties of the same goods where ten would serve. For us it is costly to pay the resultant price. Why should we continue to pay two dollars for every dollar article produced under a regime of waste?"

Professor Bliss is enormously right and I second his motion that every layman should become a missionary for standardization. Let (Continued on page 168)



"He's a prevaricator," said the frantic John J. "I have 62 wrenches—count 'em—and not one that fits the bolts on my carburetor so that I can take it off and clean it."

Stone Banks for the Mississippi



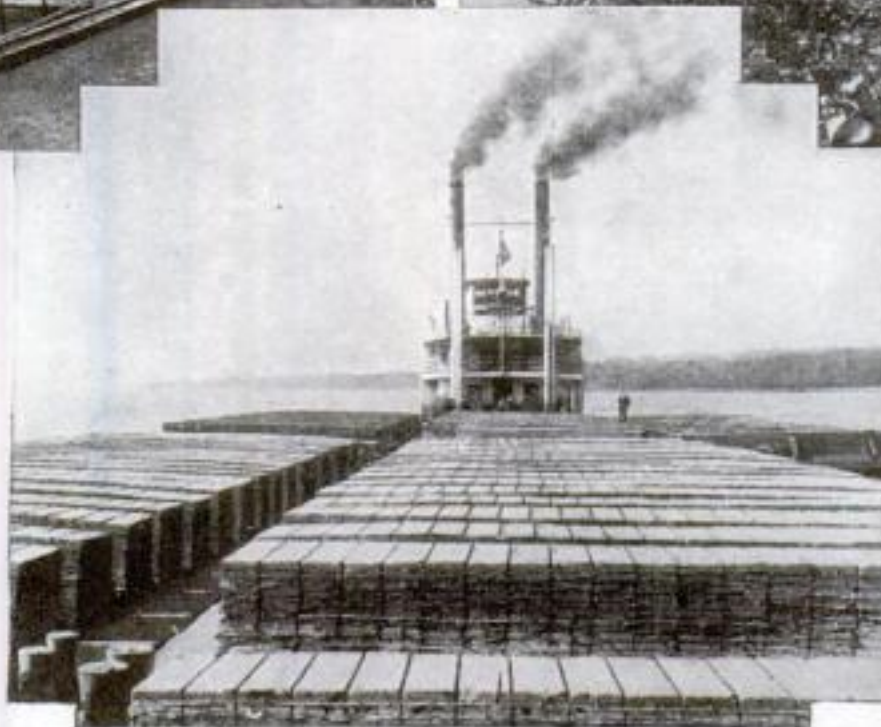
A barge carries tons of riprap—concrete slabs wired together. It is cut off in sections like cloth and a crane lays it on the river bank.



Willow trees, swung by a mighty steam crane, being woven with wire into a protective coat to guard a Mississippi levee against a flood.

A BILLION - DOLLAR job that will require three years for completion is the riprapping of the lower Mississippi River, now well under way following last spring's devastating floods. It is the most stupendous engineering project of the kind.

While this operation is not a complete solution of the flood problem, it will tremendously reduce the damage that is wrought by the furious rampages of the "Father of Waters."



Towboat moving a fleet of barges laden with concrete slabs wired together to make stone banks for the Mississippi.

The riprapping cannot prevent overflowing of the Mississippi and its tributaries, but it can save the levees and the banks from being destroyed at flood time by the tremendous pressure of water and the erosive action of the torrential currents. The riprapping consists of gigantic mats made of willow trees and sometimes of concrete slabs, woven and linked together with wire and laid on the banks and levees to protect them against ravages of the water.

New Test Questions on Aviation

1. Who was the first man to fly across the English Channel? When was it done?
2. Which type of craft is the older, heavier-than-air or lighter-than-air?
3. What country leads in air mail development?
4. How is a parachute opened?
5. How does the fuel consumption, in miles per gallon, of a light airplane compare with the fuel consumption of a light automobile?
6. What is an airway radio beacon?
7. Is air cooling used on radial engines only?
8. Why is economy an important factor in aircraft engines?
9. At what rate do propellers turn in normal flight?
10. Do all airplanes have to be licensed?
11. What is a hangar?
12. What is the name of the first airplane to cross the Atlantic?
13. What is the American record for high speed in an airplane?
14. How long does it take a normal person to learn to fly alone?
15. What is air?
16. How does density of air change with altitude?
17. How does air resistance vary with speed?

AMERICA is becoming "air conscious," and the air-conscious person must be also air-wise. Are you? Are you really at home when flying is the subject of conversation, as it so often is? If not, these questions, prepared for POPULAR SCIENCE MONTHLY by Professor Alexander Klemin, Director of the Guggenheim School of Aeronautics at New York University, will help you. The answers are on page 153.

18. What is a streamline body?
19. What is a wind tunnel?
20. Will a fast airplane of a given weight require more or less wing area than a slow one of the same weight?
21. If an airplane has an air speed of 100 miles per hour heading into a wind of twenty miles an hour, what is its ground speed?
22. What is the slipstream?
23. Is the chord always the same at all points of the wing?
24. When is an airplane considered stable?
25. What is a tail spin?

26. What is skidding?
27. When is an airplane stalled?
28. What is a three-point landing?
29. Can an airplane fly upside down?
30. What is a vertical bank?
31. What is a helicopter?
32. What is an amphibian?
33. What are the advantages of a biplane over a monoplane?
34. What is the empennage of an airplane?
35. What is the rudder and its function?
36. What is the difference between a tractor and a pusher type airplane?
37. What is a cantilever monoplane?
38. What is a tail skid?
39. What two metals are most used in airplane construction?
40. What are the principal constituents of duralumin?
41. What wood is most used in airplanes?
42. Why is "dope" used on wings?
43. Why is metal gaining in favor for airplane construction?
44. What is a disadvantage of an extremely wide landing gear?
45. What is an oleo strut?
46. What is the elevator and its functions?

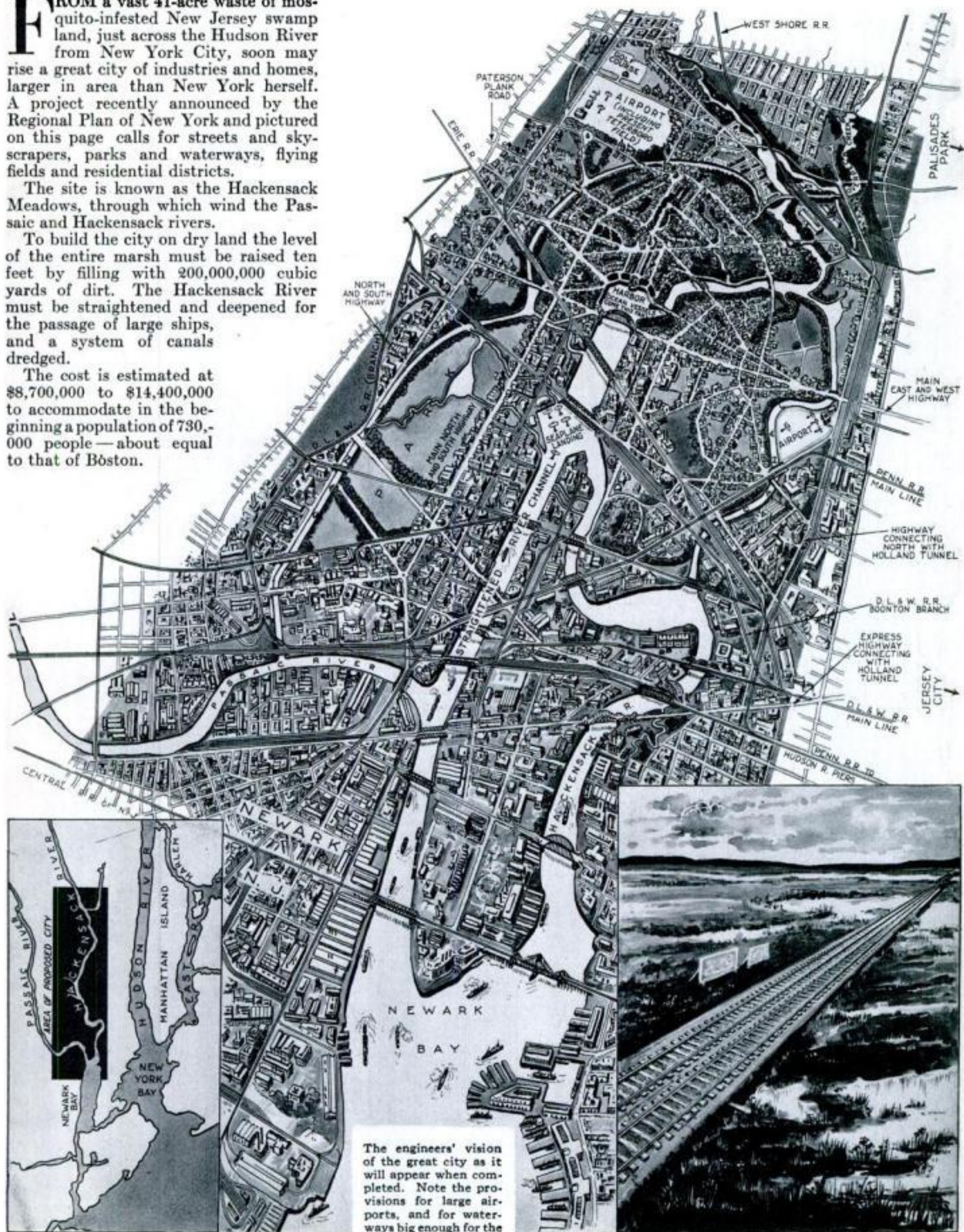
A Magic City from a Swamp

FROM a vast 41-acre waste of mosquito-infested New Jersey swamp land, just across the Hudson River from New York City, soon may rise a great city of industries and homes, larger in area than New York herself. A project recently announced by the Regional Plan of New York and pictured on this page calls for streets and skyscrapers, parks and waterways, flying fields and residential districts.

The site is known as the Hackensack Meadows, through which wind the Passaic and Hackensack rivers.

To build the city on dry land the level of the entire marsh must be raised ten feet by filling with 200,000,000 cubic yards of dirt. The Hackensack River must be straightened and deepened for the passage of large ships, and a system of canals dredged.

The cost is estimated at \$8,700,000 to \$14,400,000 to accommodate in the beginning a population of 730,000 people—about equal to that of Boston.



The engineers' vision of the great city as it will appear when completed. Note the provisions for large airports, and for waterways big enough for the accommodation of the largest of ocean vessels and seaplanes.

The black area on the small map indicates proposed site of the new city of the Hackensack Meadows.

The New Jersey marshes as they appear today. Ten feet of fill will soon turn them into dry land.



Power from your washing machine runs a compact new rotary ironer that can be kept in a drawer. It is slipped on in place of the wringer in a few moments. The padded roll, set in motion by a slight hand pressure on a convenient lever, is electrically heated.



An ironing board that you can use while traveling is seen at the left. It rests safely on any flat-topped piece of furniture, and cannot mar the finish because its folding metal legs are sheathed in rubber. At home, it serves for baby clothes and small unexpected ironing tasks.



New Tools That Make Home Tasks Easy

Just the right size for chopping a few pieces of ice, the cedar pail stoutly bound with brass, as shown below, saves your enameled sink from the ravages of the sharp ice pick. Its tongue-and-groove construction makes it leakproof, each stave fitting into the next in a joint as perfect as that of the best cask.



Scrub brush and floor mop in one is a new German device that makes the care of your floors easy. After scrubbing, the mop cloth slides beneath the brush, where a wire brace holds it firmly. A twist of the convenient handle, and the mop wrings itself. The ingenious combination tool, as shown in the picture above, is simple enough for a child to operate.



A novel clothes dryer of flexible metal straps around your hot water boiler or on a steam pipe. Clothes hung in the radiated warmth dry in a minimum of time. It will also serve as a handy rack in the kitchen pantry for cooking utensils or for brushes and brooms.



Especially suitable for a small household is a new electric clothes-washer that can be used on the drainboard of a sink, or in sink or bathtub. With its cord plugged in a wall socket, it rocks gently so as to swish suds through the garments which are placed in it, cleaning them thoroughly without damage. All moving parts are inclosed in an aluminum case.

Tar caps of any size, large or small, are whisked off in a jiffy by the ingenious new wrench at the right. Its three sets of notched rims enable it to fit any container. At the end of one hinged arm is a handy bottle opener that easily doubles the value of the novel instrument to the busy housewife.



Cleaning the garbage pail is a simple matter through the new convenience of waterproof paper receptacles that fit inside it. Each is used once and thrown away with its contents. Tabs serve as handles. This is of special value in many cities where the law requires garbage to be put out in a paper wrapping for the collector.



No screws or clamps are needed to attach this convenient new clothes drying rack to your radiator. However, the versatile rack can also be used over a gas range by crossing its hinged legs; on the floor, over warm air registers, in an open window, or on an ironing table. It will stand alone, and folds into a small bundle for storing.



With the face of this new gasoline-burning heater up-turned, you can set a dish of beans and a pot of coffee upon it for speedy cooking; or bread to be toasted. Turn the heater face to a vertical position, where it is held by a convenient set screw, and it serves as a radiant heater to warm a bathroom, camping lodge, or any small room. Although it utilizes gasoline as fuel, it lights instantly.



Bristleless Toothbrush

Semisoft, wedge-shaped little fingers that won't come out get all around the teeth and massage the gums. Cleaning the brush is simple and easy and better sanitation will be a result.

Ideas Put To Work

Burglar - Proof Doors,
Steel Gloves to Guard
Fingers of Workmen,
New Life Preservers,
Rubber Toothbrushes



Handy Tool of Ten Uses

A valuable friend is this new combination of hammer, with nail puller, screw driver, corkscrew, knife sharpener, scale, ruler, table of weights and measures and can and bottle opener.



A Garden Hose Holder

Any ordinary nozzle fits in this hinged device which is adjustable to any position from vertical to horizontal. Its standard ends in a long slender spike, which can easily be driven down by hand power without marring your lawn.



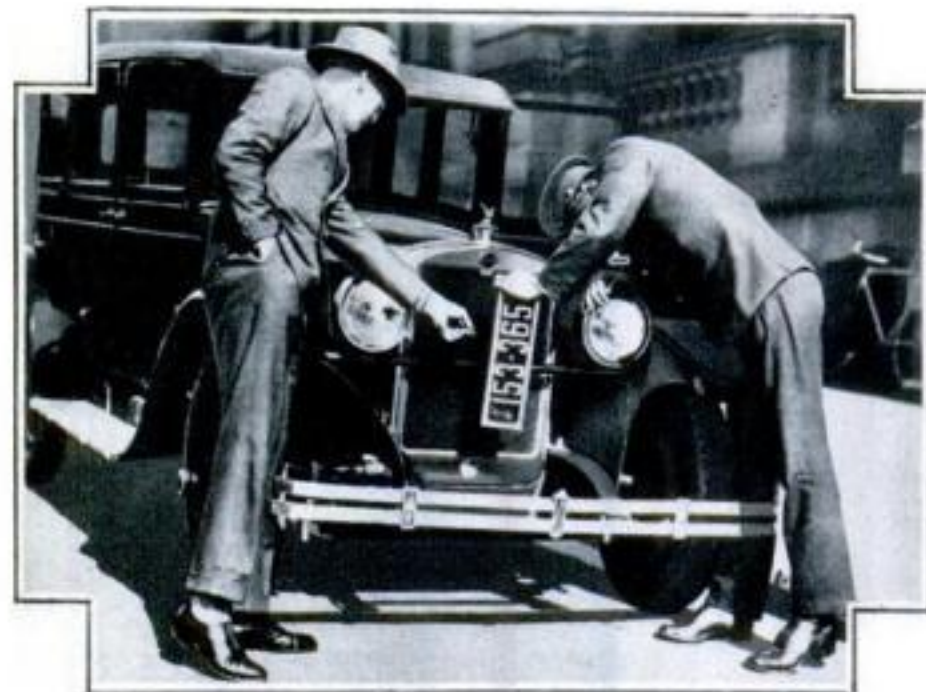
Detroit's New Giant Boulevard Lights

With 5-lamp ornamental lights Washington Boulevard takes from State Street, Chicago, the honor of the world's best lighted street. Each pole has 10,500 candlepower. In one of the lamps is the daughter of A. F. Dickerson, of the General Electric Company, who helped design them.



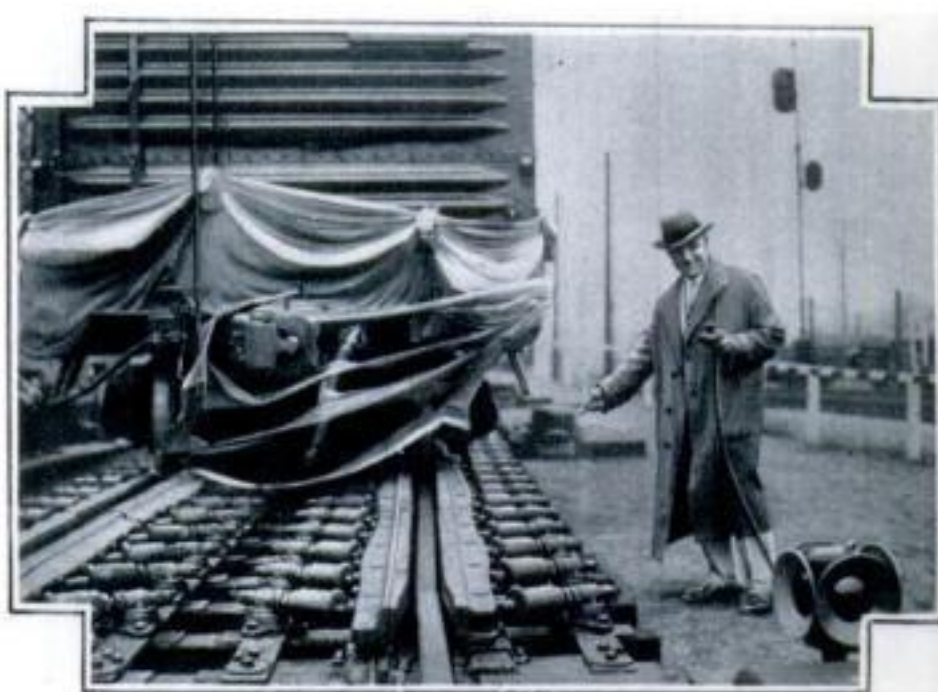
A Burglar-Proof Door

This door is kept bolted while the lady of the house opens the swinging, hinged sash and talks with the stranger through the protecting iron grille which is in the outer face of the door. Between the grille and the sash is a bronze screen, an additional convenience.



New Device That Foils the Motor Car Thief

The thief who drives off in this parked car is in for a surprise. The owner has turned the license plate to a vertical position with a lever, which is then locked so that no one can restore the plate to its proper position without the key. In Australia, where the device is used, the policeman knows what a vertical plate means.



Mechanical System That Sorts Freight Cars

Pressure of buttons and electric controls operate the \$4,000,000 car classification system recently installed in the Boston yards of the Boston & Maine Railroad, replacing many trainmen. President Hannauer, of the road, is seen pointing to one section of the system at the ceremonies which lately inaugurated its use.

Fast Electric Paint Remover

This new device speeds the work of clearing off old paint to provide a perfect surface for repainting. The long cord is run from a socket. The block, which contains a heating element, softens all the paint so it can be readily scraped off, as at the right, but the wood is not burned nor even scorched.



Machine Fills Lighter

A coin in the slot operates this novel fuel station for pocket lighters which a Frenchman has just invented. The devices are being installed in tobacco shops and in many public buildings.



New Life-Saver

The impact as it strikes the water opens the pouch of the device illustrated above and at the left, releasing the floats that hold up the rescued man. He is hauled in by the cord.



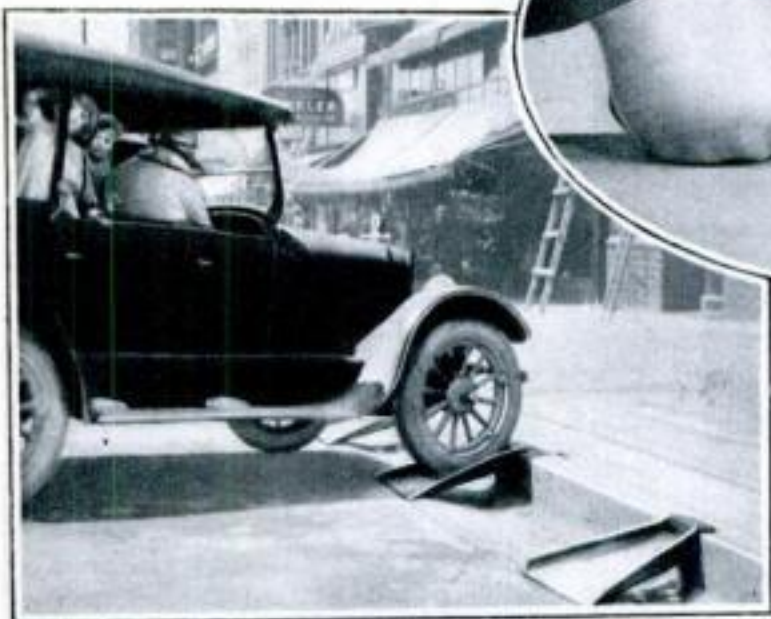
Two-Filament Miner's Lamp

If one filament fails, the miner simply turns a switch and throws the second filament into instant service, thus avoiding loss of time in obtaining a new lamp.



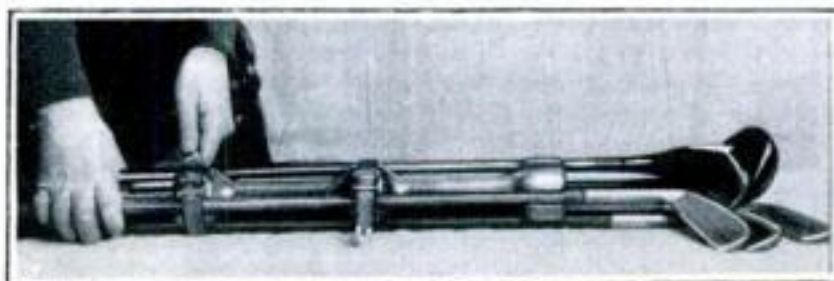
Steel Safety Glove

This new glove, woven from strands of steel, was invented by a physician employed by a large meat packing concern where the accident department records showed many cut hands and fingers. It provides excellent protection, yet is said to allow ample freedom of movement at the same time.



New Car Parking Plan

Little metal bridges over street gutters have been devised by I. G. Bench and J. D. Boyd, sheriff of Utah County, Utah, to receive front wheels of cars and thus prevent their blocking the flow of water during storms and during gutter irrigation. The plan also makes street cleaning easier and enables cars to draw somewhat farther from the middle of the street, thus giving the traffic increased space.



Cigarette Case-Checker Board

This novel case has cigarettes in one side and in the other checkers, which, when not in use, repose under the board, which forms a lid that retains them. The lid is hinged so that one half can be lifted.



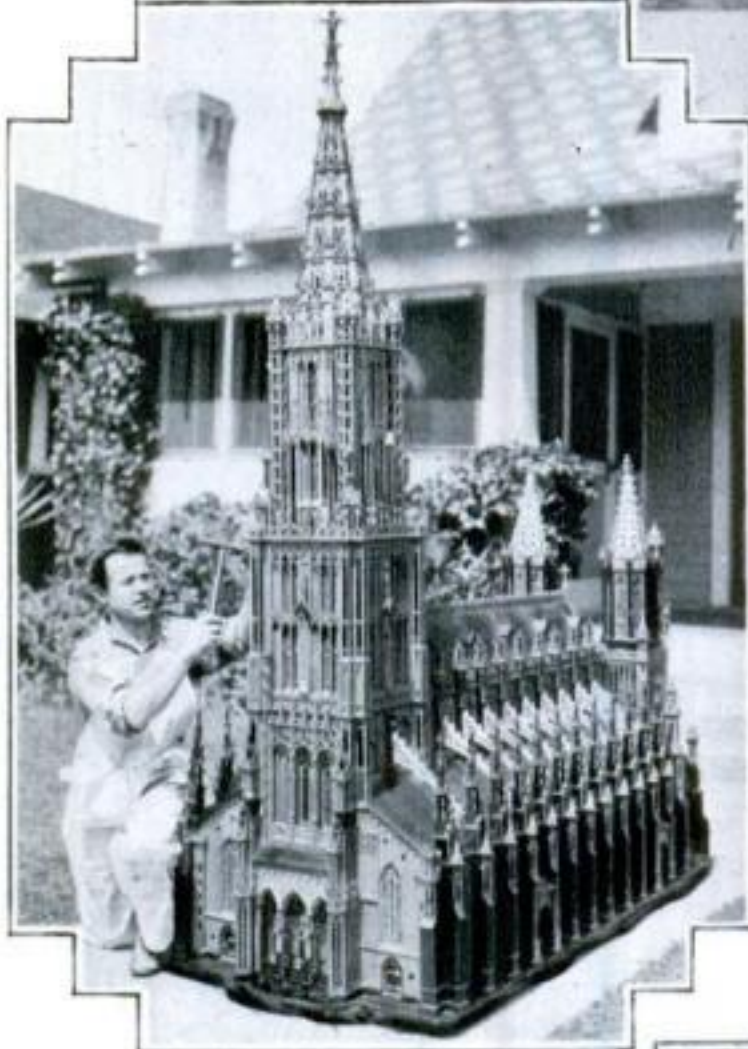
Straightener for Golf Clubs

Clubs that have been bowed through carelessness, such as letting them lie iron down all winter, are strapped into the straight grooves of this English invention. Left there a sufficient time, they are "cured."

Unusual Personalities at Work



A radical new type of airplane is the invention of James A. Crane, of Ellsworth, Me. One motor flaps wings intended to lift the plane straight up; a second motor turns the propeller.



Two years with a jackknife and Michael Molz, of Los Angeles, produced this nine foot high exact model of the magnificent cathedral at Ulm, Germany—a masterpiece of carving.



With that buzzing instrument, the drill, that makes a visit to the dentist exciting, Mars Baumgardt, Los Angeles optician, is making a huge plaster of Paris globe into a reproduction of the moon, from his own telescopic photographs.



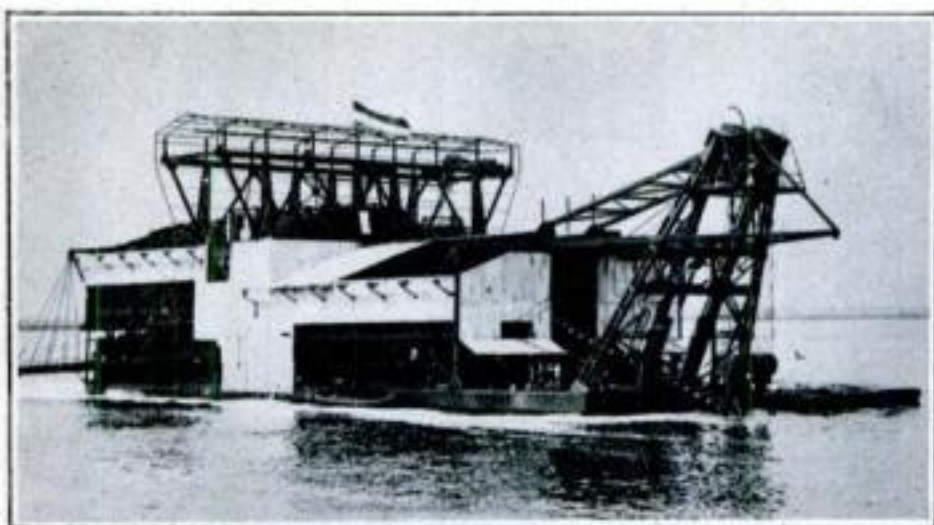
A camera that photographs the finish of a seemingly tied race, showing the slightest victory of any runner and automatically recording speed of all, has been invented by F. H. Loebner, of Berlin, Germany.



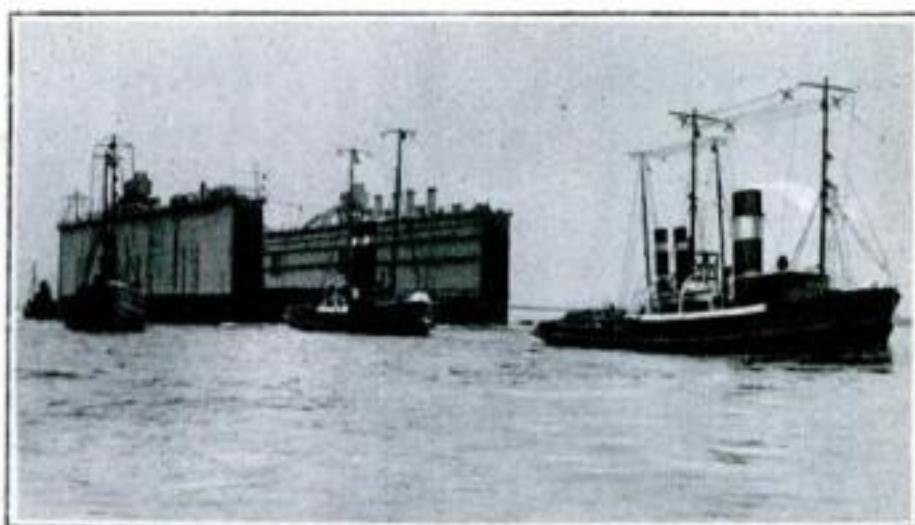
Gar Wood, famous speed boat builder and pilot (right), built this telescope for the observatory at his Florida home. A pneumatic system moves telescope and chair.



Artist and wood carver combined is L. H. Eubank, who exhibits a "painting" made of 516 pieces of inlaid wood of various colors and grains. This picture, which measures thirty by forty inches, presents a roadway through a forest of giant California redwood trees.

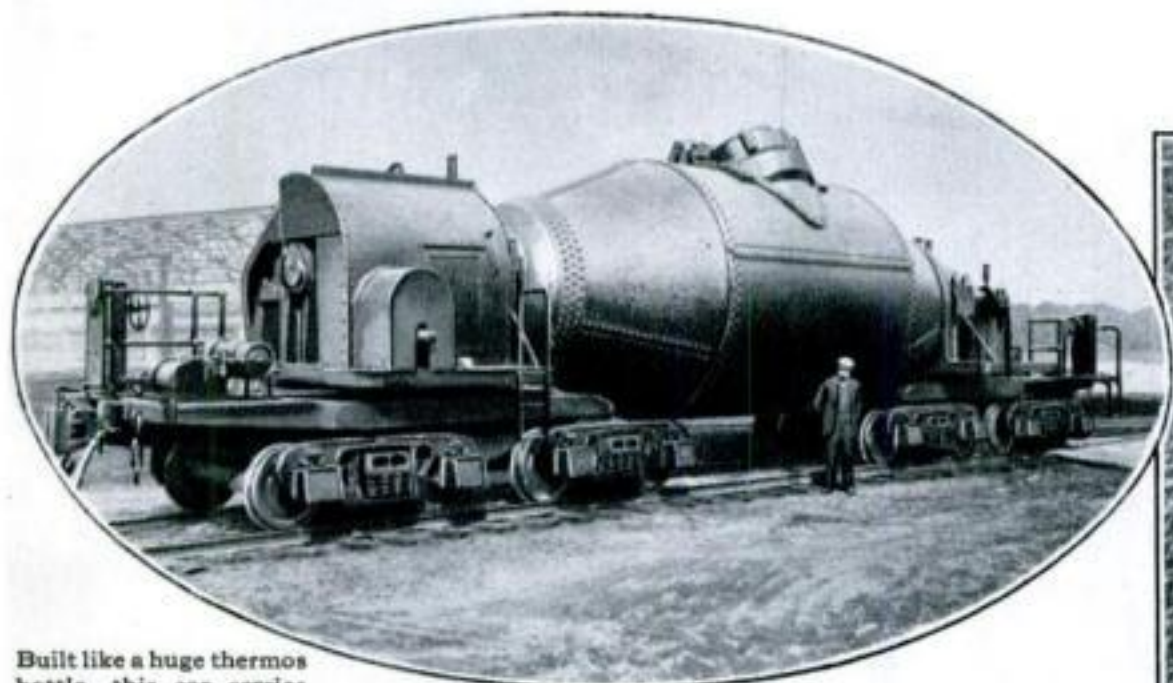


The *Cambria*, the world's largest tin dredger, which with its chain of buckets will bring up tin ore in the form of gravel from Burmese rivers, was built in Holland to be towed to Burma by way of the Suez Canal.



With ropes two feet thick, four powerful tugs start towing a 50,000-ton section of the world's largest floating dock 8,600 miles from England to Singapore, Malay Peninsula, an Oriental base for British ships.

Achievements in Many Forms



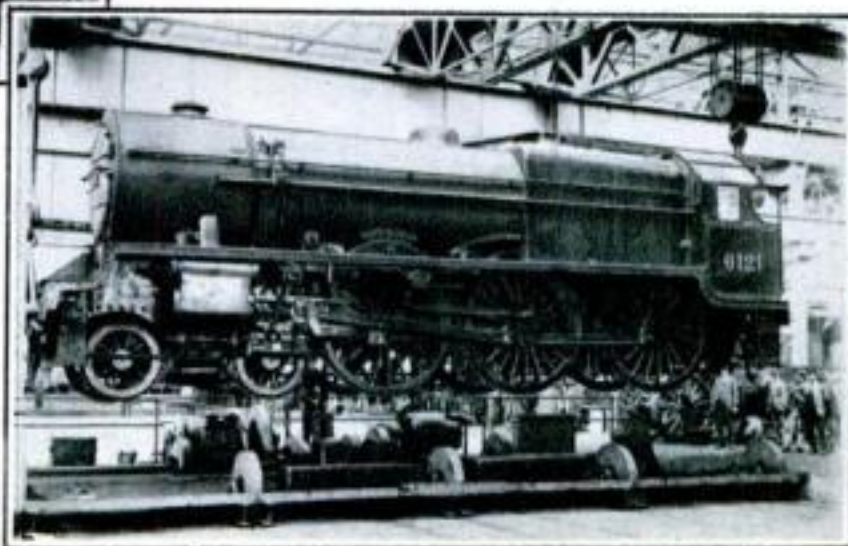
Built like a huge thermos bottle, this car carries 450 tons of molten iron 10 miles over a special track and bridge from a Hamilton, O., blast furnace to rolling mills at Middletown, O., saving the time and cost of re-melting it for the mills. The system could, if necessary, keep the iron fluid forty-eight hours.



Modern (above) and ancient (left) methods of producing oil from Burmese wells exist side by side. Between great derricks, served with supplies by aerial cables, natives use the windlass system.



Fast traveling cranes lift entire locomotives and carry them about like packages in department store carriers in an English locomotive works. Like a motor car, in a large automobile factory, an engine is shot from department to department until it is finished.

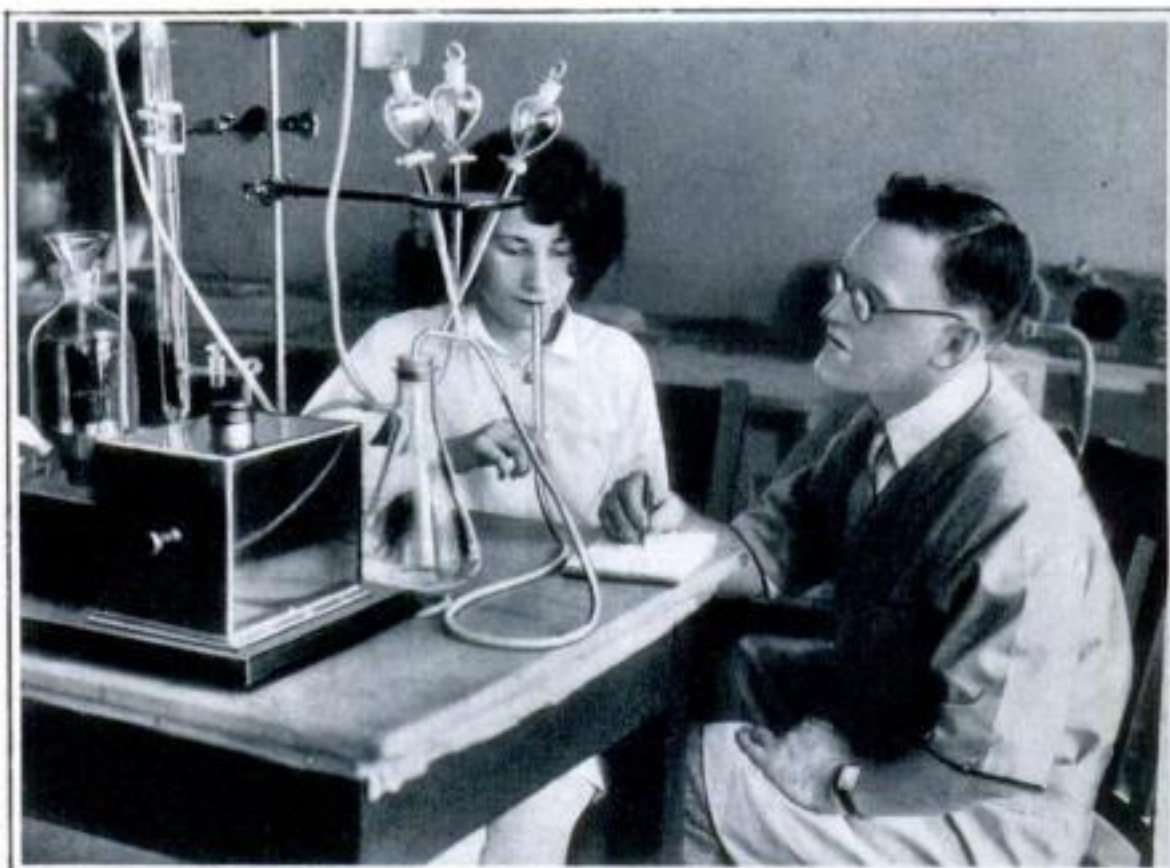


A dazzling view from an airplane of the palatial new Canadian Pacific liner *Empress of Australia*, lying under a brilliant noon-day sun in the Solent, a strait leading into the port of Southampton, England.

Keeping Pace with Science



Finding intestinal parasites of a new kind in a dead giraffe, Dr. E. W. Price, U. S. Bureau of Animal Husbandry, swallowed some to test their effects and survived severe illness. Here he is examining them.



Captain H. R. Zimmer, Los Angeles chemist whose powerful new explosive, "radium-atomite," was described in the August POPULAR SCIENCE MONTHLY, here demonstrates his device to protect luminous watch dial makers from radium poisoning. It takes and tests specimens of their breath to see if they are affected by the radium used in manufacturing the dials.



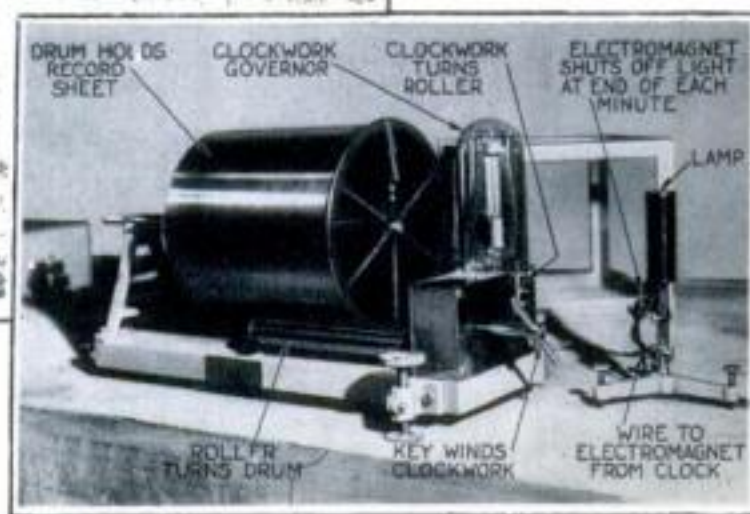
To determine the amount of oxygen the body needs to do a specified amount of labor, this scheme was devised in a German institute. The man shovels the ball up the incline. His exhaled breath goes into the bag and is later tested to find out how much oxygen he took from the air.



The fashion of light-colored leathers has led tanneries to ask the U. S. Bureau of Standards to determine the effect on the quality of leather of sulphuric acid, which is used in bleaching. Here a Bureau expert is shown examining an acid-tanned hide.



Father Tynan, of Fordham University, New York City, is here seen with the University's new seismograph, developed by Professor Wilys of Esthonia from the invention of the Russian Prince Galitzin. It is housed in an underground room and it magnifies earth shocks 1,000 times. Details of the machine are pictured at the right and left.



Milk Preserved by Radio—Human Body a Dynamo Of a Million Volts—Tears a Powerful Germicide

Radio Keeps Milk Sweet

THE newest use found for radio is to keep milk from souring.

Prof. Karl Seidel, of the University of Vienna, Austria, claims to have discovered a method by which milk, treated by radio waves of short length, can be kept sweet for from three to four weeks! Health authorities in Germany now are testing the process.

The new "radio milk" is produced by passing an intense beam of short waves through the liquid. This, it is said, instantly kills all germs which cause the milk to spoil. The milk itself is not heated by this treatment, nor does it acquire a "cooked" taste.

Do Stars "Eat" Meteors?

STARS grow; and, like all growing things, they need food for fuel. They get their food by consuming meteors with which they collide while hurtling through space.

Such are the fascinating theories recently advanced by Dr. Harlow Shapley, of the Harvard University Observatory. Even our own little earth, he says, "swallows" about thirty million shooting stars a day. The sun and other great stars consume enormous numbers.

That is how the stars keep from dying; how they replenish the energy they expend in radiation. In one second, says Dr. Shapley, our sun expends 4,000,000 tons of its substance in sending us light and heat; but in that same second a thousand million meteors drop into Old Sol's hungry jaws!

Memory Goes to Birth

HOW far back can you remember? Are you able to recall happenings when you were a baby?

J. A. Hadfield, a psychologist of London University in England, who has just completed a study of memory, finds that adults remember much more of their childhood than is commonly supposed. Among his subjects he found one man who remembered clearly a fire that occurred when he was only eight months old, and a woman who recalled what happened a few minutes after her birth! Another subject subconsciously recalls so vividly a choking fit brought on by fumes at the age of two that the recollection now induces suffering from asthma.

Parents who think babies are "too young to understand," warns Hadfield, may cause much suffering to their children in later life. Disturbing sights and events may linger in their memory to harass them in later years.

Tears a Powerful Germicide

TEAR drops may mean sorrow, but chemically they are a blessing.

Tears are composed of a chemical, called "lysozyme," which is probably

the most powerful germ killer known. Frederick Ridley, of the Royal Society of Medicine in London, experimenting with human tears, has found that one teaspoonful of the pure chemical contained in them has antiseptic powers equal to more than a hundred gallons of salty water against certain eye bacteria.

The same substance, he says, can be found in white corpuscles of the blood which continually wage war on destructive bacteria invading the body. Eventually it may be possible to extract the powerful chemical in sufficient quantities from animal bodies to place it in general use as a nonpoisonous antiseptic.



Can Chemists Save Farmers?

THE farm problem, about which so much has been said in the presidential campaign, will be solved not by politics, but by chemistry.

That is the belief of experts of the American Chemical Society, meeting at Northwestern University to consider new ways to utilize waste products of the farm.

Out of the present billion tons of waste a year, 20,000,000 tons are corn cobs and 150,000,000 tons corn stalks. Already chemistry has developed many new industries from farm waste. It has found uses for both corn stalks and cobs, oat and cotton hulls, tobacco stalks, peanut shells, swamp grass and various weeds. Artificial lumber and butyl alcohol used in making lacquer are typical examples.

But, according to Dr. Frank C. Whitmore, director of the Institute of Chemistry, only a start has been made in aiding the farmer to enjoy prosperity by finding value for products he now throws away. "There needs," he says, "to be a careful study of all substances that can be made from the farmer's products."

Man a Million-Volt Dynamo

IT MAY be that you, as well as every other person on earth, are carrying an enormous electric charge. Your body, perhaps, holds a million volts!

That startling possibility was suggested recently by Professor Fernando Sanford, of Stanford University, after completing a study of the earth's electrical condition. The only reason the potential thunderbolt does not kill you instantly, he says, is that every other object on earth, including rocks, trees, oceans—even the mass of the earth itself—is electrically charged in just the same way.

In fact, all the members of our solar system—sun, planets, and moons—probably are charged likewise. It is as though our solar system were a gigantic dynamo, generating voltages of which electrical engineers, working with the feeble efforts of man-made dynamos, can have little conception. It is because we ourselves are a part of this gigantic electrical system that we have no perception of the charge within us.

Scientific War on Rust

USING the whole United States as a laboratory, three experts of the U. S. Bureau of Standards have undertaken a gigantic experiment to find the cause and cure of corrosion, the most common manifestation of which is rust. Corrosion destroys some 21,000,000 tons of iron and steel each year, probably the greatest waste industry suffers.

To study the processes of corrosion in different soils, the experimenters recently buried 10,000 specimens of various kinds of metal pipe in forty large cities. Though most of them will remain in the ground for four years, some 2,000 pieces already have been removed and examined in the laboratory. Among valuable facts already learned are these:

The rate at which metal rusts depends largely on the nature of the soil. For example, in muck found near New Orleans and in various silt loam soils in Ohio and about Kansas City, the rate was extremely high. In other places, notably in gravelly, sandy loam near Seattle, Wash., rust was almost negligible.

Galvanized steel, heretofore considered more resistant to rust than the bare metal, proved less resistant in one instance, when samples of both were placed in the same muck soil.

Copper and brass withstood the test better than any other metals. Lead resisted corrosion well, though in a few cases it became deeply pitted.

An important phase of the tests is a study of the effects of stray electric currents in the ground, such as come from power lines, which corrode metal by the chemical action known as electrolysis.

One of the immediate valuable results will be data telling the best type of pipe to lay in a given kind of soil.

A Small BENCH

How to Build One That Will Add Vastly to Your Pleasure in Woodworking and Model Making—The Lumber and Joints to Use—Full Instructions by E. E. ERICSON



IT IS all right to do model making or other light work on the kitchen table or at a makeshift bench, but sooner or later every amateur mechanic feels the need for a real workbench.

If you have no bench, why not take the time right now to make one, and then gain back the time over and over again through the increased speed with which you are able to work? Even the most cramped attic or spare hall bedroom has sufficient vacant space for a small bench.

Although not large, the bench illustrated in Figs. 1 and 5 will serve ordinary needs for cabinetwork on a small scale, model making, toy building, and household repairs—in fact, all the work that is likely to be carried out by a handy man or an amateur cabinetmaker. In addition, it can be moved from place to place as easily as a piece of furniture.

A workbench must be strong and rigid. The errors of the inexperienced home worker in constructing a temporary bench and the later disappointments from inaccurate and unsatisfactory work are too common to be needlessly repeated. After all, it takes nearly as much material and time to make a poor bench as a good one; the difference is chiefly in the design and the care with which the work is done. No really expert mechanical ability is required. Accuracy in taking and working to measurements is necessary, for the bench must be square and level, but this requires care rather than skill.

The wood to be used depends somewhat upon what your lumber dealer has in stock. It is advisable to use hardwood for the top piece; but, if the bench is not to have excessive use, hard pine or even Douglas fir will last a long time. All parts except the top can well be of soft wood; indeed, it is perhaps better for the beginner not to attempt to make the framework of hardwood. Your lumber dealer will be glad to suggest the most economical and serviceable woods he has on hand for this purpose.

YOUR order, as you will give it to the lumber dealer, will be practically as follows:

Douglas fir (or equivalent), clear, S4S (that is, surfaced on four sides)—1 pc. 3 by 3 in. by 12 ft., for legs; 1 pc. 2 by 3 in. by 16 ft., for rails; 1 pc. 1 by 3 in. by 10 ft., for three rails for drawers; 2 pcs. 1 by 1½ in. by 12 ft. (or blind-stop) for runs for drawers; 1 pc. 1 by 6 in. by 16 ft., for drawer fronts and backs; 1 pc. 1 by 6 in. by 14 ft., for ends and bottom of

tool recess at the back of the bench top. Maple or birch, clear, S4S—1 pc. 2 by 14 in. by 4 ft., and 1 pc. 1½ by 2 in. by 8 ft., for the top.

Beaded ceiling, 30 lin. ft., ⅝ by 4 in., for ends and back.

Quarter round, 1 pc. ½ in., for tool trough and legs.

Plywood, pine or poplar, 3 pcs. ¼ by 18 in. by 3 ft., for drawer bottoms.

The thicknesses and widths mentioned are nominal sizes and represent the sizes of the boards before they are dressed at the planing mill. When delivered, 1-in. boards will be a scant ⅞ in. thick, and the width will be about ¼ in. less than that specified.

If the 2 by 3 in. material and the 1½ by 2 in. hardwood or any of the other sizes are not in stock, purchase a shorter piece of greater width, from which the required parts can be ripped.

The hardware and metal fittings should be purchased



Fig. 1. Planing at the bench. Note how a drawer helps to support the long board.

at the same time as the lumber. Some of these may have to be ordered, and it is well to allow time for shipment. The following will be needed:

Twenty-two No. 14 flat-head bright screws, 3½ in. long, and 8 No. 12, 2¼ in. long.

Sixpenny finishing nails, 1 lb.

Four small iron brackets for fastening bench to floor.

Eight fasteners for fastening top to frame.

Six drawer pulls (wooden ones will do if desired).

Vise, 7-in. jaws, rapid acting, or continuous screw.

Lench stop.

WHEN the lumber has been delivered, the first step is to cut the pieces roughly to the length in which they will be used. Remember that haste makes waste. It is a wise plan to lay out and label each of the pieces before doing any cutting. This is the cutting list:

Legs, 4 pcs. 3 by 3 by 32 in.

End rails E, 4 pcs. 2 by 3 by 18 in.

Back rails and lower front rail, 3 pcs. 2 by 3 by 36 in. Other front rails F, 3 pcs. 1 by 3 by 36 in.

Top G, 1 pc. 2 by 14 by 48 in. (probably already cut to size).

End cleats for top, 2 pcs. 1½ by 2 by 20 in.

Back edge piece for top, 1 pc. 1½ by 2 by 48 in.

Bottom for tool trough, 1 pc. 1 by 6 by 48 in.

Drawer fronts J, 3 pcs. 1 by 6 by 31 in.

Drawer backs H, 3 pcs. 1 by 6 by 30 in.

(Continued on page 159)



Fig. 2. Mr. Ericson uses a combination plane to plow grooves in the rails; strips can be nailed on instead.

Fig. 3 (upper circle). Strips are nailed on the legs to correspond to grooves in rails.

Fig. 4 (lower circle). Making mortise and tenon joints is not the hard task that many beginners think. Mark the legs by placing the end of each rail in position.



Building Modernistic Lamps

Three Brilliant Designs for Lights in the New Mode—Cost Is Low, and Construction Easy

By
HERMAN HJORTH



LAMPS are such vital, intimate accessories in the modern home, it is but natural that they should be touched by the magic wand of modernistic art. Lighting fixtures designed in the modern manner have been much in evidence in recent furniture exhibitions and have been generally acclaimed.

Two designs for modernistic table lamps are illustrated, one on this page and at the top of page 134, and another at the bottom of page 134. A third design, which is for a stand with an integral lamp, is given on page 135—a combination piece particularly characteristic of the modern styles.

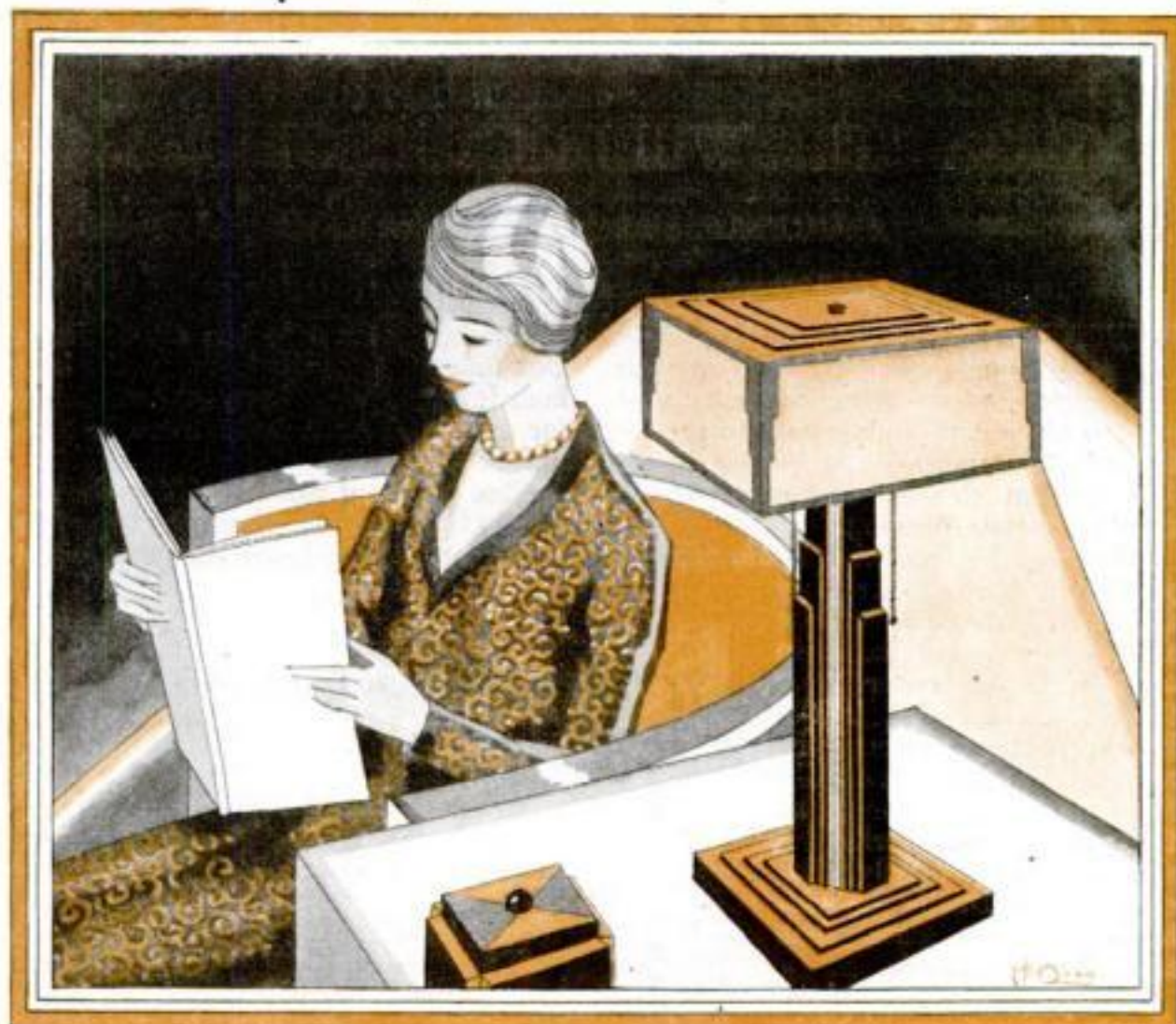
Large drawings and details of all three, together with lists of materials, are contained in POPULAR SCIENCE MONTHLY Blueprint No. 93. This will be sent to any reader for 25 cents (see page 102).

The construction of the lamps is very simple, much simpler, indeed, than it appears to be at first glance. It is also unusually interesting because so many different materials are used.

Taking first the lamp with the skyscraper upright, you will see that the base is composed of four pieces. These must be squared carefully to dimensions. A slight bevel is planed on the edges of the three thin pieces as shown, before they are fastened to the bottom piece with thin glue and brads driven in such a way that the heads will be covered by the pieces above.

Bore a hole in the center of the base on its underside large enough for the $\frac{3}{8}$ -in. pipe lock nut. In the center of this hole bore another hole $\frac{1}{16}$ in. in diameter right through the base for the $\frac{3}{8}$ -in. pipe. Bore a $\frac{3}{8}$ -in. hole in the center of one of the edges of the bottom piece and fit a metal or composition bushing into it.

The core of the upright is made by nailing and gluing together two pieces of wood $\frac{3}{8}$ by 2 by $22\frac{1}{2}$ in. and two pieces $\frac{3}{8}$ by $1\frac{1}{4}$ by $22\frac{1}{2}$ in. Chisel a square hole about 1 in. deep in the center of the top of the base to receive this boxlike up-



As the magnificent set-back skyscraper differs from its insipid forerunners, so this table lamp differs from the usual commonplace, characterless lamps so'd in furniture stores. And it is simply made.

right. Then prepare the twelve pieces that give the skyscraper offset effect, and glue and nail them in place.

SCREW the pipes and fittings together as for any table lamp and locate the position of the two $\frac{7}{16}$ -in. holes which must be bored through opposite sides of the column to correspond in height with the fixture "hickey."

Use two 45-degree ball fixture nipples with $\frac{1}{8}$ -in. brass nipples $\frac{3}{4}$ in. long and fasten them in the holes with lock nuts. Run wires through and make connections at the fixture hickey so that two fixture wires can be run through the central pipe and out at the base.

The first step in the construction of the shade is to glue together two pieces of $\frac{1}{4}$ -in. plywood, the larger one exactly 16 in. square and the smaller one $15\frac{3}{4}$ in. square. The difference represents twice the thickness of frosted glass, which has been taken as $\frac{1}{8}$ -in. but may vary; therefore, buy the glass before making the shade.

Next prepare the top three layers respectively $13\frac{1}{2}$, 10 and $7\frac{1}{4}$ in. square. Glue and nail them together. Bore a $\frac{1}{16}$ -in. hole through the center of the top. On the underside chisel a square hole $\frac{1}{4}$ by 2 by 2 in. deep to fit the top of the upright.

Two of the pieces of frosted glass should be $7\frac{1}{4}$ by 16 in. and two the same width but shorter in length by twice the thickness of the glass, that is, $15\frac{3}{4}$ in. or a trifle more or less.

The four metal corners are made of sheet brass (or copper) cut with a pair of tinner's snips, filed smooth on the edges,

and bent into shape. They should be fastened to the top so that the glass is held firmly at the lower side of the 16-in. square plywood piece. A band of metal $\frac{1}{2}$ in. wide is nailed along the edge of this piece. It should be given a little inward bend at the corners so that it fits tightly against the glass. It may be found advisable to insert a narrow strip of felt between this metal band and the glass to prevent rattling.

WHEN the shade is placed on the upright, the pipe should project about $\frac{1}{4}$ in. above the top. A brass cap screwed to the pipe holds the shade firmly in place.

The inside of the top of the shade should be either painted white or silvered to reflect the light downward. A narrow band of gold bronze also may be painted along the lower edges of the four pieces of glass to correspond with the brass corners and band. The further decoration of the lamp will depend upon the color scheme of the room. Many suggestions for color schemes and hints on finishing modernistic pieces have been given in the preceding articles in this series (August and September issues).

The construction of the base and upright of the second table lamp is practically the same and needs no further comment. It is suggested that a parchment shade be used for this lamp. It may be bought ready-made or constructed and decorated by the builder. For making such shades there is a new transparent material on the market that can be

(Continued on page 134)

Capt. E. A. McCann Describes Two Ways of Building

A Case for Your Ship Model



That Will Inclose in Glass and Keep Safe from Dust and Accidental Damage the Rigging and Other Fragile Parts

IF YOU have built a small ship model with much fine detail and delicate rigging, you will undoubtedly wish to place it in a glass case to protect it from the ravages of the feather duster, the vacuum cleaner, and other implements of house cleaning.

The very first model I made when a youth on the clipper ship *Oriana*, I put under a glass shade or bell glass like those once used to cover wax flowers, clocks, and knick-knacks. These covers still may be obtained, but luckily they are not so common as they used to be. Perhaps I should not say "luckily," because it was usually the contents, not the glass, that seemed objectionable.

Better than one of these glasses is a rectangular glass case such as you can make yourself, either with or without a wooden frame. A case with a frame is always the stronger; a frameless case is neater, but slightly more expensive.

A framework case requires a baseboard large enough to come clear of the bow, the stern, and the yardarms by a margin of 2 in. In each corner, 1 in. from the edges, make a hole $\frac{1}{2}$ in. square. Then prepare some $\frac{1}{2}$ in. square strips, as shown in the accompanying drawing, with rabbets on two adjacent sides to receive thin picture glass. Walnut is a good wood to use.

Cut four pieces of this stock for the top frame, making each piece of a length to come exactly to the outer corners of the holes in which the upright posts will stand. Miter each end horizontally so as to form a square frame, and also miter them vertically to receive the mitered upper ends of the uprights as illustrated.

CUT the uprights long enough to extend a full inch above the mastheads and at the same time project through the baseboard and extend them 1 in. below it. The lower projecting ends serve as small feet for the case.

Miter the uprights on the two outer sides to fit into the

triangular notches in the upper frame. Cut four other strips to lie on the baseboard; these should have only one rabbet for glass and must be notched into the uprights.

Glue pieces of wood to fill in the rabbets in the legs from where the top of the base comes to the lower ends of the feet.

to produce substantially the same effect.

Obtain a neat stock molding—not rabbeted like picture-frame molding—and miter this to fit tightly around the base with its top edge level with or a little higher than the top of the base. In this way a slot is formed to receive the standing sheets of glass.

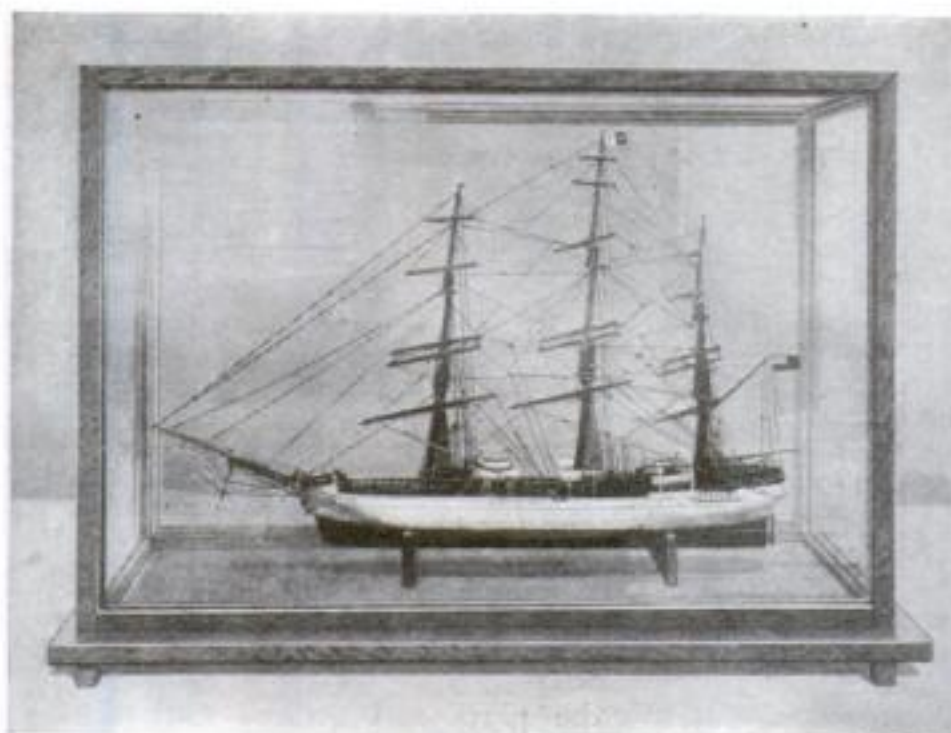
Unless you are skilled in glass working, take this base to a glazier and have him cut two pieces to fit the full length of the side walls and of a height to clear the mastheads; then two end pieces to fit between these; and one sheet to cover the other four. The edges should be ground smooth, so I suggest that he cut the pieces a trifle large and grind them to the exact size. Neat corners are essential. It is advisable to use thin French plate, which is thicker than the glass ordinarily used for windows.

The sides and the ends, which stand upright in their slots, should have their edges neatly cemented together, and the top piece should be cemented to them. Use a cement sold especially for use on glass or chinaware.

Where there is sufficient floor space, a case may be made to stand on legs. The lower part can be in the form of a table or a cabinet and the upper part made as previously described. If, however, the case is to stand against a wall, it may have wooden sides and back with a glass front and top, or even a glass front only. For the inside of such a case, a pale grayish sky blue is a good color.

IF THE model is to be taken in and out frequently, the front may be fitted with glass doors hinged at the sides, but as center bars then are necessary, this construction should be avoided in a case made primarily for exhibition purposes.

As a general rule, it should be added, I prefer the larger and more rugged models without glass cases. They gather a lot of dust, to be sure, but dust on them does not annoy me as much as it would on almost anything else. If well made, models will stand being gently flicked with a feather duster. The best way to dust them, however, is with a large camel's-hair or soft paint brush.

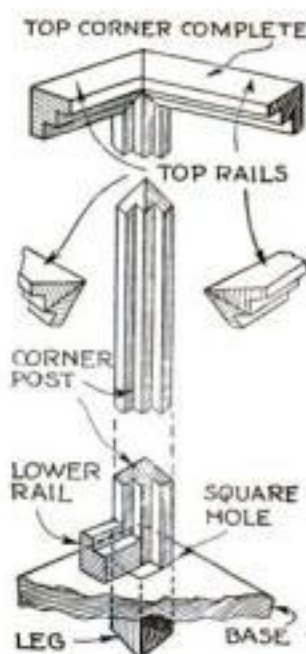


Model of the *Torrens* with 14 in. long hull; it was built by Captain McCann and inclosed in a glass case for protection.

Have sheets of glass cut to fill in the sides, ends, and top, and keep them in place with thin battens screwed into the corners.

Set the uprights in the holes through the base and mark them just under the baseboard. Remove the base and bore $\frac{1}{8}$ -in. holes through the uprights so that when the uprights are in position the holes will be partly covered by the base. Then, by pressing tapered pegs into the holes, the base and the frame can be held tightly together—a rigid and dustproof construction.

When a case is made without any framework, a base is required that is at least 1 in. larger than the over-all dimensions of the model and not less than 1 in. thick. Cut a rabbet right around the base not less than $\frac{3}{4}$ in. down from the top; the rabbet should be of a depth to correspond with the thickness of the glass to be used. Instead of cutting a rabbet, you can, if you wish, fasten a batten around the lower edge



How the wooden framework is joined at upper and lower corners of the case.

New Ways to Paint Radiators

Stippled, Polychromed, and Flat Finishes—Color Schemes—How to Use Sprayers—And Simple Hints to Increase Heating Efficiency

By BERTON ELLIOT



Radiators are now decorated to harmonize with their surroundings. A good time to refinish them is before the fall fire is started.

AFTER remaining for years unchanged as an object of often garish and commonplace appearance, the radiator now is yielding to the artist's touch, like all our household furnishings.

Radiator covers to protect walls and curtains from dust, as well as to beautify the appearance of the heating coils, have come into common use. Recesses sometimes are left in the walls for the radiators so that they can be wholly or partially concealed; and in some new houses built-in radiators are provided. In finishing radiators when they are exposed to view, color combinations are being used to harmonize with the general decorative scheme.

If the proper colors and types of finishes are chosen it is now possible, because of researches which have been conducted by engineering societies and universities, to save many dollars in your coal bills. That is because you can choose a type of finish that will cause practically no impairment in the radiation of heat as compared to



Applying a stipple coat with a sponge to match a so-called Tiffany finished or mottled wall.

other finishes which may retard radiation as much as fifteen percent.

By refinishing radiators before the fire is started for the winter, the home owner can improve the appearance of his rooms with very little effort and at small cost. The essential idea is to make the radiators less conspicuous. This is accomplished by using colors that blend with the background. In certain cases, however, a necessary accent in a room can be obtained by decorating the radiator in contrasting color. When a wall of plain color constitutes the background, the color may be matched with flat wall paint.

For radiators that stand in front of paneled woodwork in enamel finish, enamel of the same color can be used and a touch of contrasting color applied to the ornamental embossing with a camel's-hair pencil brush. If a good match cannot be obtained in standard shades of wall paint or enamel, you can use oil colors, which come in tubes or small cans especially for tinting purposes, to tint a standard shade until it does match. Your dealer will tell you the proper tinting color to use, and by experimenting with small quantities you can mix the color you need.

If the wall decoration is wall paper of a pronounced pattern or paint-stippled or Tiffany two-tone blended effects, the ideal treatment for the radiator is stippling. This will harmonize with the background perfectly.

The first step is to make sure that the radiators are in good condition for repainting. They must be thoroughly clean and free from grease and dust. Wash them with soap and water. Clean any greasy spots with gasoline, and scrape and sandpaper all scaling or rusty places.

If the radiators happen to be new and never have been painted, or if the finish is in a very bad condition, apply a priming coat of red lead-in-oil and boiled linseed oil, or other rust-inhibitive metal paint.

Give the radiator two solid covering coats of flat wall paint of the desired



Flat-drying paint of the kind often used for walls is ideal for decorating the radiator coils.

foundation color. The stippling then may be done in two ways.

The simplest method is to apply the color with a sponge cut across the grain to give a good painting surface. Pour some of the stippling color on a board or a piece of paper, dip the sponge into the color, tap it out two or three times on a piece of paper to remove the excess paint, then pat it straight onto the radiator without twisting or turning. Reload the sponge with color and continue the process until the entire surface has been covered. When the paint is dry, a second and even a third stippling *(Continued on page 131)*



With a sprayer, whether hand-, foot-, or motor-driven, it is easy to finish radiators.

High Lights of Aero Progress

Device Invented for Refueling In the Air—Flying Post Offices Will Sort Mail—Record Smashed For Barrel Rolls—Safer Plane Built—Flyer Can Carry Hangar

BETWEEN New York and San Francisco on the transcontinental air mail route, the first "air post office" will shortly be put in service, Postmaster General New announces. Postal clerks will ride with the mail and sort it in the air. The new service, which may later be extended to others of the twenty-three mail routes now in operation, is made necessary by the increased volume of air mail following the recent reduction of rates.

Postal clerks eager to be transferred to the air have filed their applications already; the first was Walter O. Tucharber, of Olathe, Kansas, mail clerk for twenty-two years, who applied for the position last November.

Plane Carries Its Own Hangar

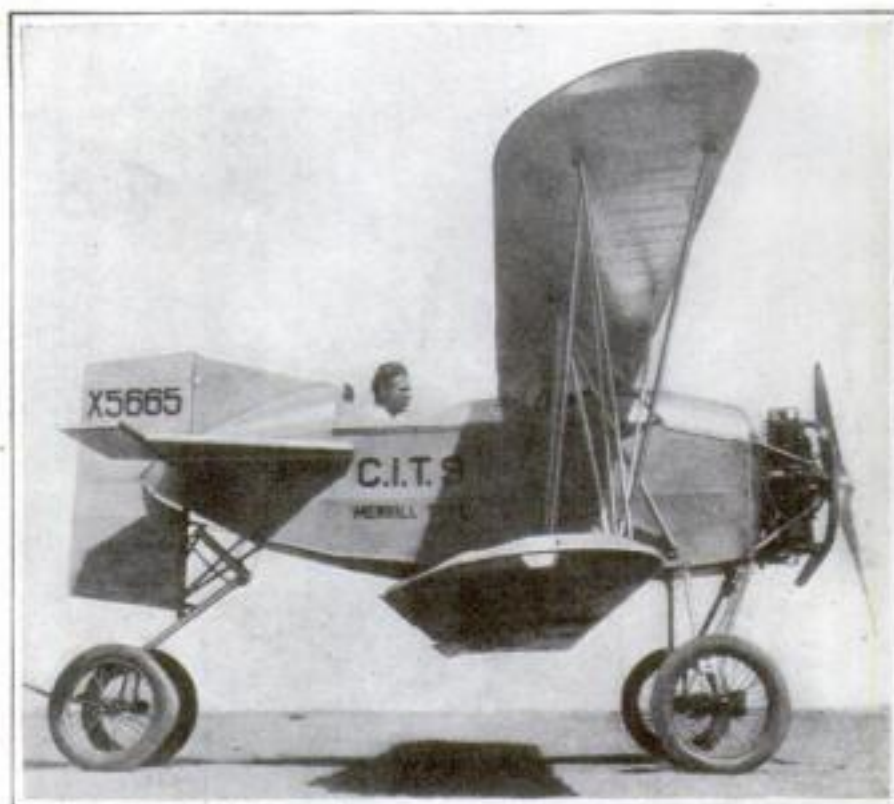
A HANGAR you can carry in your plane's cockpit, and unroll and set up wherever you land, is the latest novelty to be offered flyers. It shelters a plane completely, giving adequate additional space for working. When taken down, the fabric shelter rolls into a compact bundle with its stakes, guys, and collapsible poles, and it weighs only 110 pounds.

First Link Ready In Air-Rail Line

AS THIS issue goes to press, the first air-rail passenger service in the United States is scheduled to commence, according to Col. Paul Henderson, Vice-President and General Manager of Transcontinental Air Transport. The air link, between Chicago and Minneapolis and St. Paul, serves passengers arriving in Chicago via the Pennsylvania Railroad's Manhattan Limited and drops them at the twin cities of Minnesota three and a half hours later. Returning planes connect at Chicago with the Broadway Limited to New York.

Connections are made at Minneapolis-St. Paul with trains of the Northern Pacific, the Great Northern, and the Chicago, Milwaukee, and St. Paul Railroads. Tickets pro-

The lower wings of this new biplane designed by experts of the California Institute of Technology can be moved forward or backward to almost any desired angle and then set in that position. The set is determined according to the speed desired and the rest of the plane's mechanism is synchronized with this speed. Stalling is claimed to be eliminated.



vide for travel via the Pennsylvania Railroad between New York and Chicago, the airplane line to Minneapolis-St. Paul, and railroad to points beyond. Airplane seat reservations are made like Pullman reservations, and heavy baggage may be carried.

The new service is a preliminary step in the forty-eight-hour coast-to-coast air and rail line expected to open in late fall or early winter, and which will directly connect Los Angeles and Chicago on a part of its route. Passengers will fly by day and sleep in fast trains at night.



Imagine the size of the *Inflexible*, the world's largest airplane, pride of Great Britain, when its landing wheels, as shown in this picture taken at the air pageant at Croydon, are eight feet high. This all metal, tri-motored craft weighs fourteen tons, has a wing spread of 150 feet, and is seventy-five feet long. The Air Ministry's purpose in building the plane is secret, but it could easily carry 7 tons of bombs.

Plane Almost Flies Itself

SAWED-OFF airplanes of a new type developed at the California Institute of Technology and illustrated above are said to represent an advance in safety and efficiency. A novel control mechanism permits the whole lower wing to be slid forward or backward in flight to the most favorable "staggered" position for stability at a given speed. The upper wing has no aileron, or balancing flap, and the tail is used only to steer. In the air, one of these curious planes is said almost to fly itself without the pilot's aid; and on landing it can be brought to a stop in thirty or forty feet, making it ideal for landing on small fields.

Barrel Roll Record Smashed

TWISTING like a corkscrew through the air, Thursder Johnson, of St. Paul, spun eighty times in the evolution known as the barrel roll the other day to set a world's record. Previously twenty-six had been the record for this stunt, called the most sickening known to aviation, in which the plane continues its forward motion while spinning like a screw.

Propellers Made of Cotton

COTTON cloth and canvas, impregnated with resin, are two of the latest materials of which airplane propellers have been made.

In efforts to develop a nonbreakable propeller that would have a certain very desirable elasticity and resist corrosion and moisture, the cotton fabric was placed in layers until the thickness desired was obtained, and then molded into blocks under tremendous pressure and heat. From these woodlike blocks propellers were sawed and drilled. In experiments they proved entirely successful, as did similar air screws that were manufactured from canvas.



A mighty crane at Hamburg, Germany, lifts the fuselage of the new Rohrbach Romar flying boat to a ship that will carry it away for tests on the Baltic Sea. This splendid craft is claimed as the largest, strongest, and most powerful flying yacht ever built. It is manned by a crew of five and has a passenger carrying capacity of twelve. In addition to passengers, baggage and ample provisions can be carried.

Planes for Sale—\$695 Up

VARIETY in plenty awaits the prospective airplane purchaser, according to a recent survey of eighty-nine types of commercial and private planes made by sixty-one manufacturers. For a sum that varies from \$695 to \$60,000, it is possible to buy a plane with a capacity of from one to fourteen occupants. Thirty-three types are supplied with wheel brakes as standard equipment, and forty-seven models have their wings wired for lights, for flying at night.

Two tiny one-man flivver airplanes, weighing but 290 and 275 pounds respectively, are interesting features of the survey. The first, a monoplane made by a Chicago concern, has a wing spread of twenty-three feet, is powered with a motorcycle or small airplane motor, cruises at sixty-five miles an hour, and sells for \$695. The other, a biplane produced in Sacramento, Calif., has a wing spread of only twenty feet, uses a twenty-five-horsepower motor that gives it a cruising speed of seventy-five miles an hour, and costs \$1,165.

Crawls Under Speeding Plane

ONCE there was a joke about a scared dorky automobile mechanic who declined to fly for fear he might have to "get out and get under" to repair his machine in the air. Now that remarkable feat has been performed by Paul Charles, airplane pilot of Gettysburg, Pa.

Flying with a friend, Charles heard thumping sounds on the fuselage and, looking out, saw his damaged landing gear flapping loose. Since he knew he could not land safely, he circled over the Gettysburg airport and attracted the

attention of another pilot, who flew aloft to drop him a rope. Then, with the friend at the controls, Charles crawled five times beneath the fuselage of his speeding plane, repaired the landing gear with a piece of rope, and returned to his cockpit to make a perfect three-point landing.

Air Mail Letter Circles Earth

AN AIR letter that traveled around the globe to its starting point in seventy-one days is said by its sender, Osborne B. Bond of New York City, to have set a new record despite mishaps which delayed it along the way. Only a part of its journey—between New York, where it was first mailed and Seattle, and between Basrah and

Cairo, Egypt, was by airplane.

An unforeseen delay occurred when the mail liner *Empress of Canada*, carrying the letter westward across the Pacific, rammed a Japanese freighter and was laid up for repairs. Nevertheless, the letter, readdressed at each stopping place and bearing the postmarks of New York, Seattle, Hongkong, Singapore, Colombo, Dhanushkodi, Karachi, Basrah, London, and New York, returned to its sender in record time.

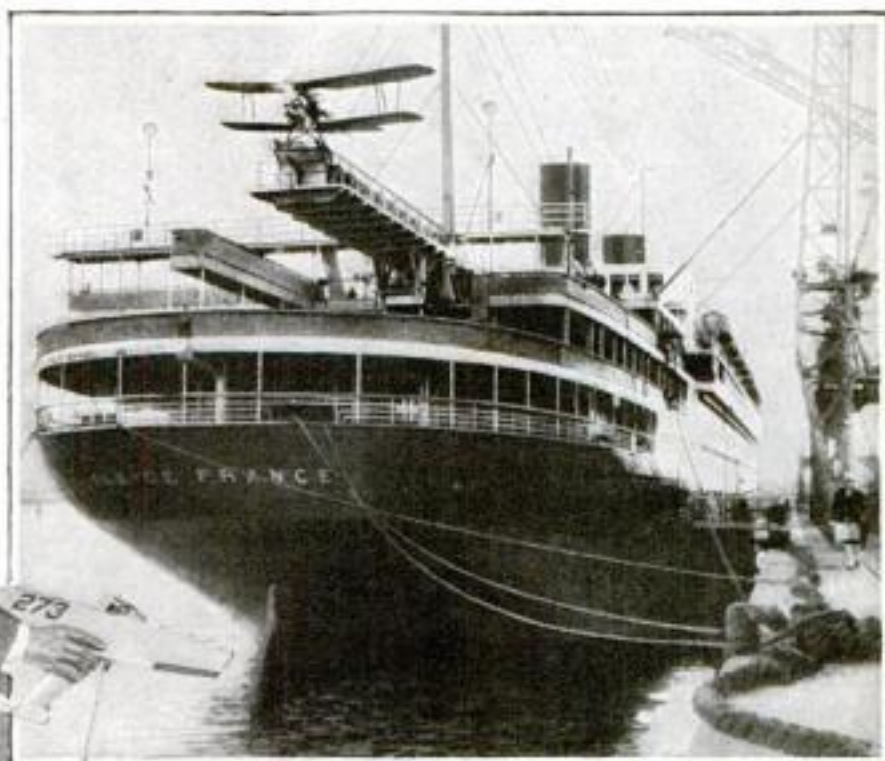
Reliability Tour, 6,300 Miles, Is Completed by 24 Planes

LIKE a covey of birds returning home to roost, twenty-four of the twenty-five airplanes that started the 1928 reliability tour for the Edsel Ford trophy returned to Detroit the other day, after an unparalleled record of motor efficiency and maintained schedule. A thirty-two-leg course had taken them over a route of 6,300 miles, twice over the Rockies, and covering seventeen states; with them flew the referee, Ray Collins, of Detroit, in an Army Air Corps scout plane. One plane had dropped out early.

John P. Wood, of Wausau, Wis., who flew a Waco biplane, was declared winner on a basis of points scored for efficiency on each leg. Nine women were among the seventy-five persons who made the tour; Mrs. Phoebe F. Omlie, only woman pilot, flew alone in her tiny Monocoupe over Western mountain ranges and deserts.

Navy Bids All Officers Fly

THE Navy believes that an officer who knows how to fly is a better officer. That is the interpretation of a recent order that, since all officers cannot attend flying schools, their private flying is to be encouraged. When questions of promotion and retirement arise consideration will be given to men who have taken up flying independently. Three qualified naval aviators, pilots, or observers have recently been promoted to the rank of rear admiral.

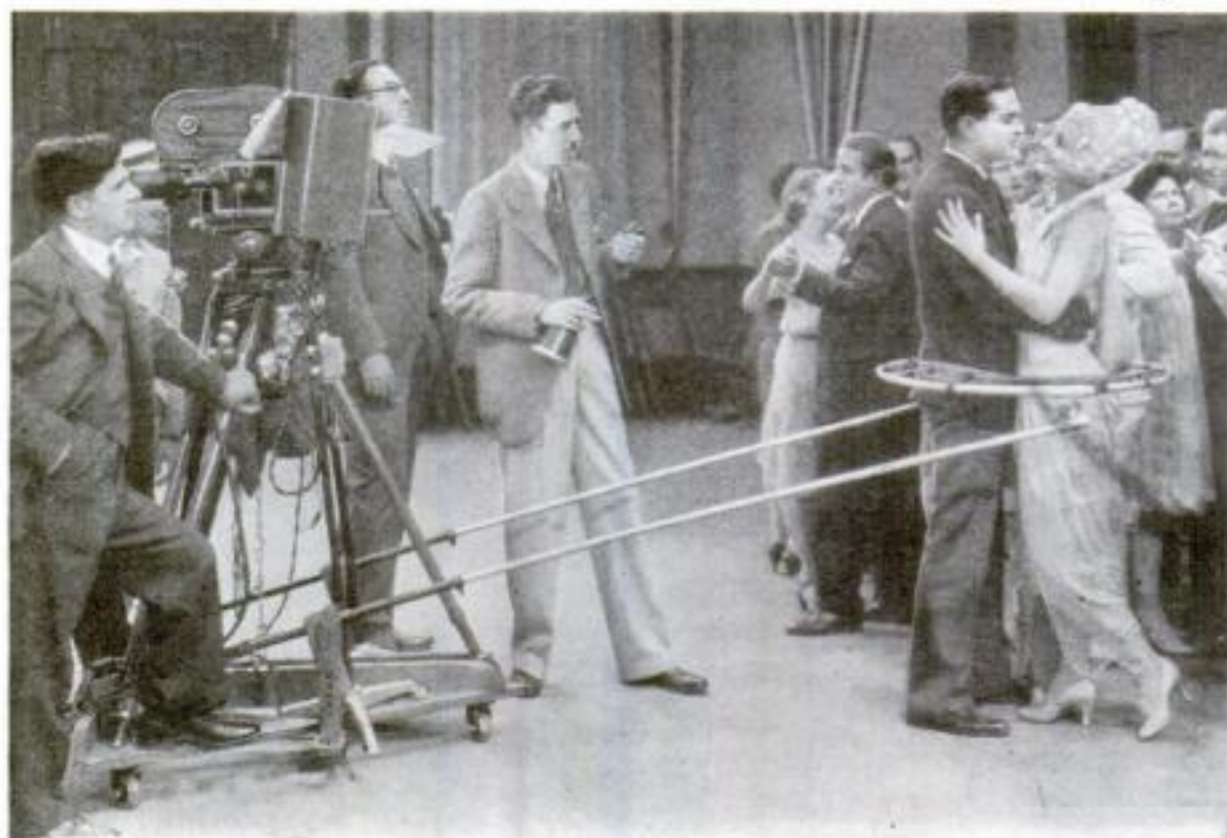


With a landing field and a launching catapult for a seaplane on its after deck, the palatial liner *Ile de France* has been equipped to speed mail between New York and Havre when it gets within striking distance of the ports. The arrangement increases the speed of mail 24 hours each way. The innovation results from Clarence Chamberlin's demonstration of its practicability. The plane may also carry a limited number of passengers, besides the mail.



The problem of refueling and taking on mail and provisions in flight may be solved by the new device invented by Dr. L.S. Adams, of Seattle, who is seen at the left with a model of his invention, making a demonstration prior to the building of a full-size specimen for trial on a Seattle field. A ball on the end of a cable is unreeled from the plane into the apparatus. The ball, guided into a narrow channel, engages a socket to which is attached the package. Then the cable is reeled in, drawing up ball and package to the plane, speeding through the air.

Movie Camera Harnessed to Dancing Couple



A camera mounted on a rolling platform is harnessed to dancing couples in a Hollywood motion picture studio, so that it follows them wherever they go and always keeps them entirely in perfect focus.

DID you ever wonder how a close-up movie scene of a dancing couple was made? Here is the secret, as practiced at one large studio. The whole camera and tripod are mounted on a movable platform, drawn across the floor by a harness that encircles the dancers. Thus the couple remains always clearly focused, squarely in the camera's fields of vision. In the finished picture, of course, the harness is not seen.

"Wheelbarrow" Police Forts

"WHEELBARROW forts" form the latest aid in fighting criminals. London policemen have just tried out the idea. Full length bullet-proof shields are mounted, as shown below, on little-wheeled trucks that can be run into position whenever a gang of thugs is fighting at bay. They each afford protection for two policemen, at the same time enabling them to see ahead and to fire at different angles. These wheeled shields can move rapidly about and in following dangerous quarry can pass, if necessary, through narrow places or up stairways.

Questions Answered

THIS magazine is always more than glad to answer readers' questions regarding any subject within its field and to supply names and addresses of manufacturers of articles described in its columns. Inclose stamped, self-addressed envelope for the reply and write to Information Department, POPULAR SCIENCE

MONTHLY, 250 Fourth Avenue, New York City. But remember that the necessary research may sometimes delay the answer.

Coal Dyed Pink and Blue

WHAT color coal will you burn this winter? Blue coal is the novelty introduced by one great concern, of Buffalo and Rochester, N. Y. In the last of several washes the coal receives on its way to the consumer, it is treated with a blue dye to make it more attractive. The dye costs only three or four cents a ton, and does not affect the heating value. Meanwhile an anthracite company of Pottsville, Pa., is trying a dye that will color its coal a pink tint.



This London sham battle shows how the police can wage war with greater effect on bandits by the aid of steel shields, mounted on trucks. From behind each shield two policemen can fire in safety.

Big Mail Carrying Torpedoes Would Go 225 Miles Hourly

STREAMLINED mail-carrying torpedoes, whizzing along on eight rubber-tired wheels at 225 miles an hour on a track thirty-five feet above the ground—this is the plan presented by two French engineers, Augustin Talon and L. Hirschauer, who estimate that such machines could attain their maximum speed in sixty seconds. A third rail is designed to hold the wheels on the track and to supply current to the eight-horsepower electric motor within. The track, suspended by piano wires, is to stretch across the countryside much as high tension cables do at present. For distances of 250 miles or less, the engineers declare, such torpedoes could transport sixty-six tons of letters a day, the speeding shuttles being sent away at forty-second intervals, each bearing a cargo of sixty pounds of mail.

A Gasoline Torch of Sand

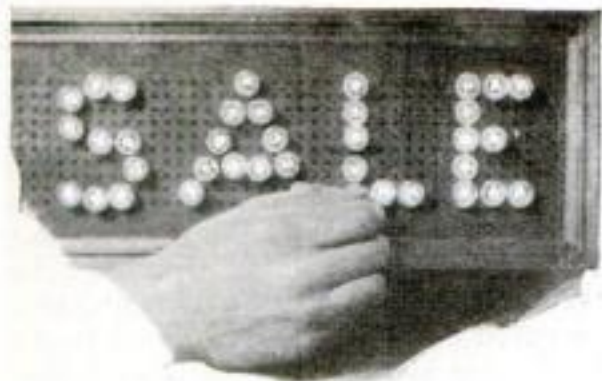
WHEN you are stranded on the road with tire trouble, late at night, and no flashlight is at hand, a makeshift trouble light is easily provided. Scrape up a small pile of sand, pour about a cupful of gasoline on it, and ignite. It will burn fifteen or twenty minutes.



"Nerve Center" of Air Traffic

THE "nerve center" from which pilots flying over American air mail and transport lines get their information about weather and other matters important to their safety is shown in the photograph above. From a station on the twelfth floor of the Department of Commerce Building in Washington, D. C., the information is transmitted by telegraph, as seen in the picture, to the powerful Arlington Naval radio broadcasting station.

This phase of aviation has progressed more rapidly in Europe than in America. The control officer at the Croydon Airport, outside of London, for example, keeps in constant touch with every air liner flying from, or to, his port. He talks with each pilot every ten minutes, gets his exact location, knows when he reaches his destination and, in the event of a forced landing, gets the exact position and immediately dispatches a relief plane to the spot. In pre-aviation days Croydon, now one of the finest airports in Europe, was just a cow pasture.



Print Your Own Electric Sign

YOU can write in electric lights with a novel changeable electric sign. By fitting the lamp sockets into perforations in a vulcanized panel, anyone can spell out messages without having had any previous experience in hand lettering. The new display panel is recommended by its makers for use in stores to mark different counters and to announce special bargains, as well as for other purposes where an illuminated sign is desirable.

Taming Waves to Save Beach

ALL along the Atlantic coast of New Jersey, ocean waves have been tearing away the beach for years. Authorities of popular seaside resorts have taken counsel, and now, at Allenhurst, N. J., they are installing a unique sort of break-water to tame the waves—an offshore pipe that fills the surrounding water with compressed air bubbles, through a system devised by Philip Brasher, Princeton, N. J., engineer.

Out from the shore runs the pipe, to turn at right angles several hundred yards from the water's edge and run parallel to it. Perforations along the pipe loose the air bubbles, compressed by a shore pumping station, which break up the incoming waves. Allenhurst has obtained from the New Jersey Board of Commerce and Navigation an appropriation of \$20,000, to be paid if the device proves successful. In other installations, notably on the Pacific Coast, the Brasher device is said to have quieted storm waves, averting pier damage and the resulting expenditure.

Speed in Phone Information

DID you ever wonder how "Information" found the telephone number you requested in those few seconds before her reply? The photograph at the right shows how it's done at Cleveland's new information bureau, where the names, addresses, and telephone numbers of thousands of subscribers, printed on cards, are kept in rotary files that can instantly be whirled to the proper index mark. A "staggered" line-up, with the operators side by side but facing in different directions, gives each girl three rotary files, containing a complete directory, within easy reach. In larger cities two more files can be arranged near the operator, giving her five in all.

When subscribers change their addresses or numbers, a typist of ordinary ability can have the new data in the files within a few minutes through an attachment for a typewriter that cuts a thin aluminum stencil from which the new cards are printed in any number that is wished.

Attention, Inventors! Here's What the World Is Crying For

THE new annual edition of "What's Wanted," an English book suggesting needed inventions, has just been published by the Institute of Patentees. Among the new wants it lists are:

A pencil that makes a mark as black as ink.

An indicator to denote when an iron is hot enough to use without scorching.

Ink that dries at once and will not blot.

A device to consume or absorb stale tobacco smoke in a room.

A device to alter the height of tables and sinks to fit the height of the user.

A collapsible umbrella to fit in the pocket.

A device to protect pedestrians from being splashed by passing motor cars.

An apparatus to eliminate or absorb the fumes from motor exhausts.

A vacuum cleaner to take up leaves and rubbish from parks and gardens.

A magazine hammer that automatically supplies a new nail after one is driven in.

A chemical process for rendering paper documents and bank notes fireproof.

A system to convert sound into energy.

Rubberized fabric for heels, toes and soles of stockings.

A contrivance to attract dust from the atmosphere of a room as a magnet attracts steel filings.

A camera that will operate in the dark.

Bus seats that will give tickets and indicate when the journey's end is reached.

A device to record telephone messages automatically when there is no one to receive them.

At the home of POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York City, a similar book has been compiled from the many suggestions sent to the editor. Any reader is always welcome to come and look it over.



A new English hand bag is shown at the left as it is ordinarily used and above with the raincoat attachment unfolded to ward off a shower.

Hand Bag Is a Raincoat, Too

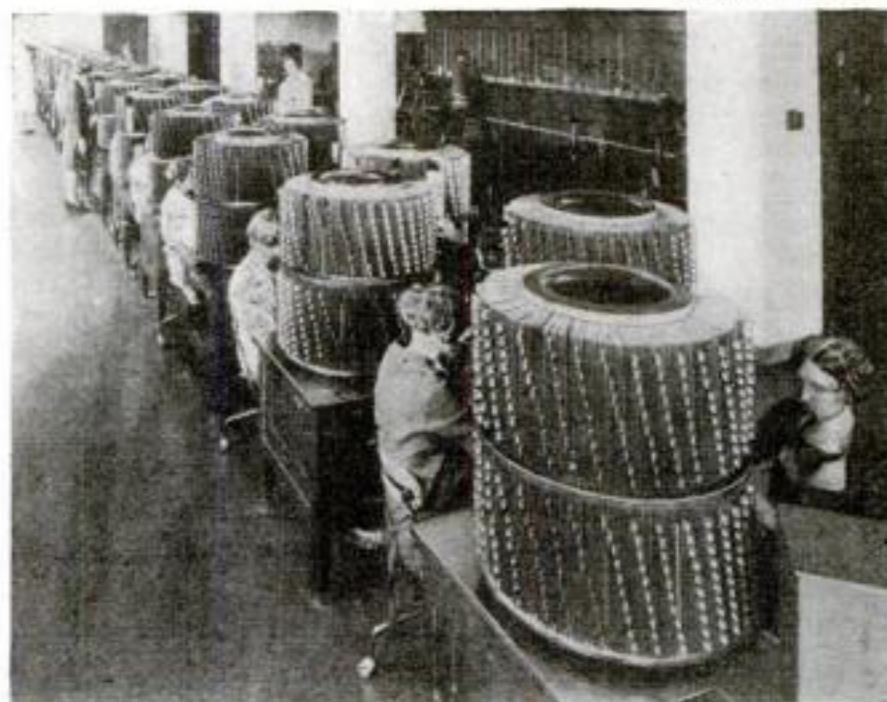
IF IT rains, get inside part of your hand bag and keep dry! That is the advice of the English inventor of a hand bag with a raincoat attached—and certainly showers should have no terrors for the owner of this device. When not in use, the coat folds up and forms the outer covering of the bag. When the coat is donned, the bag hangs down the back on the inside, where it is kept dry. It comes in a number of colors and its total weight is less than one pound.

In the pictures, it is shown in ordinary use as well as ready for a rain.

Acid Bath for Piano Keys

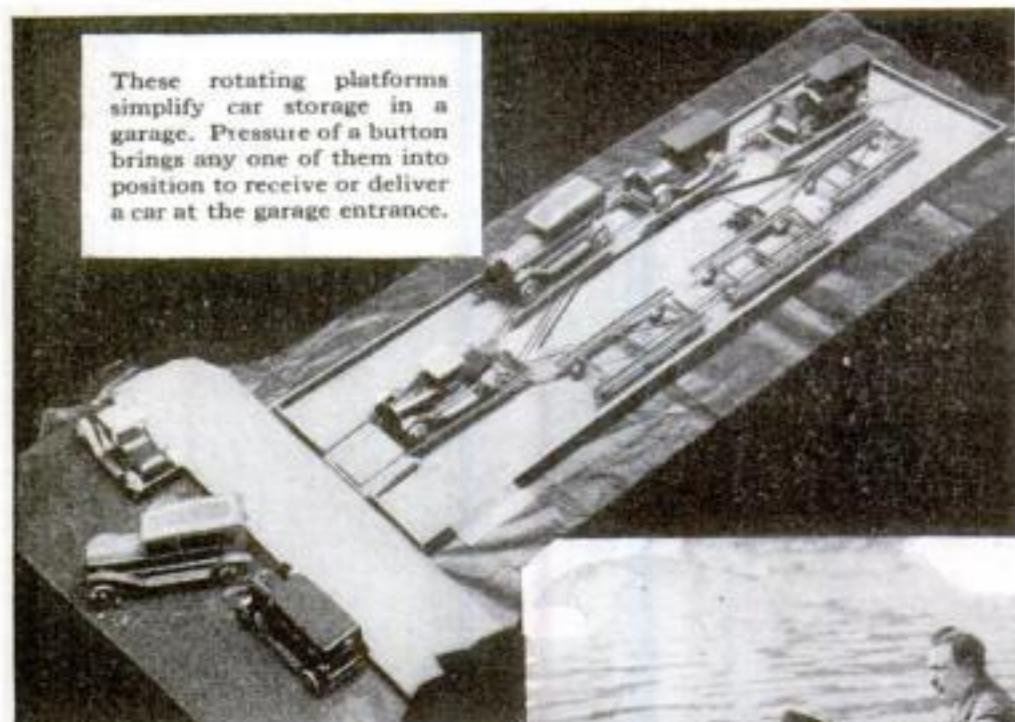
YELLOWED piano keys may be restored to their original whiteness, science has learned, with a solution made by pouring one ounce of nitric acid, slowly, into twelve ounces of soft water. Do not reverse this; for nitric acid is destructive to skin and clothing and may safely be handled only in this way, to avoid boiling and spattering. Never pour acid close to the eyes.

Apply the solution with a brush, carefully avoiding contact with woodwork. Wash it off with clean flannel dipped in water, and wipe with a dry cloth. The same mixture efficiently cleans the handles of cutlery.



Revolving files with operators set among them in the telephone information bureau in Cleveland—an arrangement that provides each operator immediate access to a complete list of the new numbers.

Merry-Go-Round Storage Plan for Motor Cars



These rotating platforms simplify car storage in a garage. Pressure of a button brings any one of them into position to receive or deliver a car at the garage entrance.

Like the propeller of an airplane, this device that looks like an electric fan, just introduced in Germany, drives a boat with surprising speed—although it is driven only by a one-cylinder engine. A handle regulates the speed and the propeller is shifted to steer the craft.

A VERITABLE merry-go-round for parked cars is the endless carrier devised by Joseph D. Bell, of San Francisco, to conserve storage space in small garages. It also makes it easy for a motorist to obtain instant access to his car. Six movable platforms, each with space for one automobile, are rotated by the touch of an electric button. In parking, the car is driven on a vacant space and whirled to the back of the garage by the button control; to regain it, all the owner need do is revolve the series of platforms until his car comes opposite the entrance. Not only is space saved, but no time is lost in waiting for the garage man to appear.

Explorer's Sea-Going Auto

A SPECIALLY built automobile that plunges in and swims across streams and lakes is part of the equipment of an expedition sent to study the Aleutian Islands. These islands, extending 1200 miles into the Pacific from the coast of Alaska, contain active volcanoes about which little is known. The leader of the expedition, Dr. Thomas A. Jaggar, has been volcanologist for the U. S. Weather Bureau for a number of years. The amphibian automobile, which runs along the ground on a regular four-wheel chassis, cuts through the water with eight or nine people in its boat-shaped body. Below, car is seen entering water.



This amphibian motor car was built for Dr. T. A. Jaggar to go through lakes and run up on land in studying the Aleutian Island volcanoes.

Odd Mineral Masked as Coal

ONE of the oddest minerals in the world is Gilsonite, a brilliant black asphaltic substance found only in Utah that is in demand all over the world for use in manufacturing paint, varnish, ink, and telephone mouthpieces.

It was discovered in 1862; but it was not successfully marketed until 1904, when the rich Black Dragon vein in the Uintah Basin was connected with the outside world by a railroad which has to wind twenty-four miles over the mountains and climb to an elevation of 8,437 feet in order to reach a point that is only six miles distant by air line.

Early settlers thought Gilsonite a new variety of coal. When it burned, however, it gave off dense black smoke with a peculiar odor. Instead of being reduced to ashes, the material melted and drew out into tarlike threads.

The mineral is exceedingly brittle and mining is made unpleasant by the clouds of chocolate-colored dust that rise when operations begin. This dust softens under the heat of the body and penetrates the skin. Water will not remove it and the miners have to resort to heavy oils, alcohol, or turpentine to get relief.

The name of the mineral came from Samuel H. Gilson, a pioneer who spent many years seeking a market for the strange substance, which now plays so large and important a rôle in the manufacturing world.

Boat Run by Air Propeller Works on Plane's Principle

A TINY motor boat run by an electric fan—or what appears to be one at first sight—has appeared in Germany. *The Canadian Seagull*, as it is called, has shown surprising speed. The propeller, mounted on the rear, is inclosed to prevent injury to passengers and lest clothing become entangled in its whirling blades. The little one-cylinder motor is fed from a small tank mounted on the top of the propeller guard, as seen in the photograph below. A handle attach to the side of this guard is fitted with a motorcycle grip to regulate the speed of the motor. The propeller is mounted on a bearing so it can be swung from side to side to steer the craft. Evidently the small size of this clever device has in no way detracted from its efficiency.



Helium for Everyone

FOR the first time, helium gas, used instead of inflammable hydrogen gas to float balloons and dirigibles, has been placed on the open market. Formerly the government controlled this country's supply, which came almost exclusively from its plant at Fort

Worth, Texas; but with the opening of a new plant to extract helium from natural gas at Amarillo, Texas, officials of the U. S. Bureau of Mines announce that abundant helium at moderate cost is now assured not only for the War and Navy Departments, but for the whole country generally.

The new field will make the safety gas available for non-Governmental airships, and also for such industrial purposes as treatment of caisson divers for "bends" and filling radio tubes and glow lamps.

How Much Do You Know of the World You Live In?

Test your knowledge with these questions, chosen from hundreds asked by readers. Correct answers are on page 161.

1. Where were seashells used for money?
2. What are the nomads?
3. Where do natives regularly cook their food in hot springs?
4. On what island are human beings forbidden either to die or to be born?
5. Where are the greatest diamond mines in the world?
6. What river has the deepest canyon?
7. How are icebergs formed?
8. Where do hurricanes occur?
9. What is the highest altitude regularly inhabited by man?
10. What is the oldest town on the American continent?

World-Wide Hunt for Radium Planned by Carnegie Expert

WORLD-WIDE search for new sources of radium, probably the world's costliest substance, is to be made by Dr. Charles S. Piggot, of the Geophysical Laboratory of the Carnegie Institution at Washington, D. C., he recently told the Washington Academy of Science. Not long ago Dr. Piggot detected the presence of the rare ray-producing metal in the granite of Stone Mountain, Georgia, although in too small quantities to pay for its extraction.

At present a large part of the world's supply occurs in the carnotite ore mined in Colorado; it has been augmented in recent years by the discovery of additional deposits in Europe and Asia, notably in Turkestan. There is still in the whole world, however, less than four ounces of the precious substance already mined.

Tools Shape Workers' Hands

THAT the shape of the bones in a man's finger may show that he is a carpenter is one of the novel conclusions of a recent German investigation reminiscent of the fictional detective feats of Sherlock Holmes. Under the X-ray, experts found, peculiarities in the shape of a workman's fingers revealed that they had long used a plane or similar wood-working tool. Eventually it is hoped to amass sufficient data to detect any man's occupation by his physical characteristics. Such an end would have at least one practical use; it might assist in the design of new tools better adapted to the original shape of the hand.

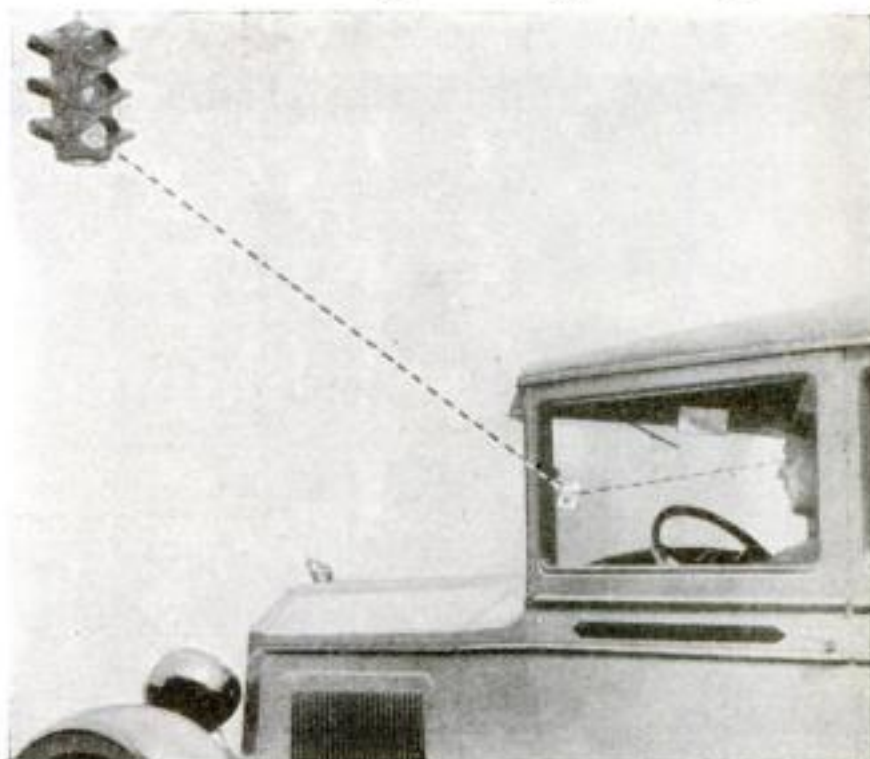
Know Your Car

YOUR car is most likely to skid on wet pavements just after the rain has started. The first drops unite with the dust to form a slippery film. A heavy downpour washes this away. The most dangerous of all skids is the front-wheel skid, but, fortunately, this does not happen very often.

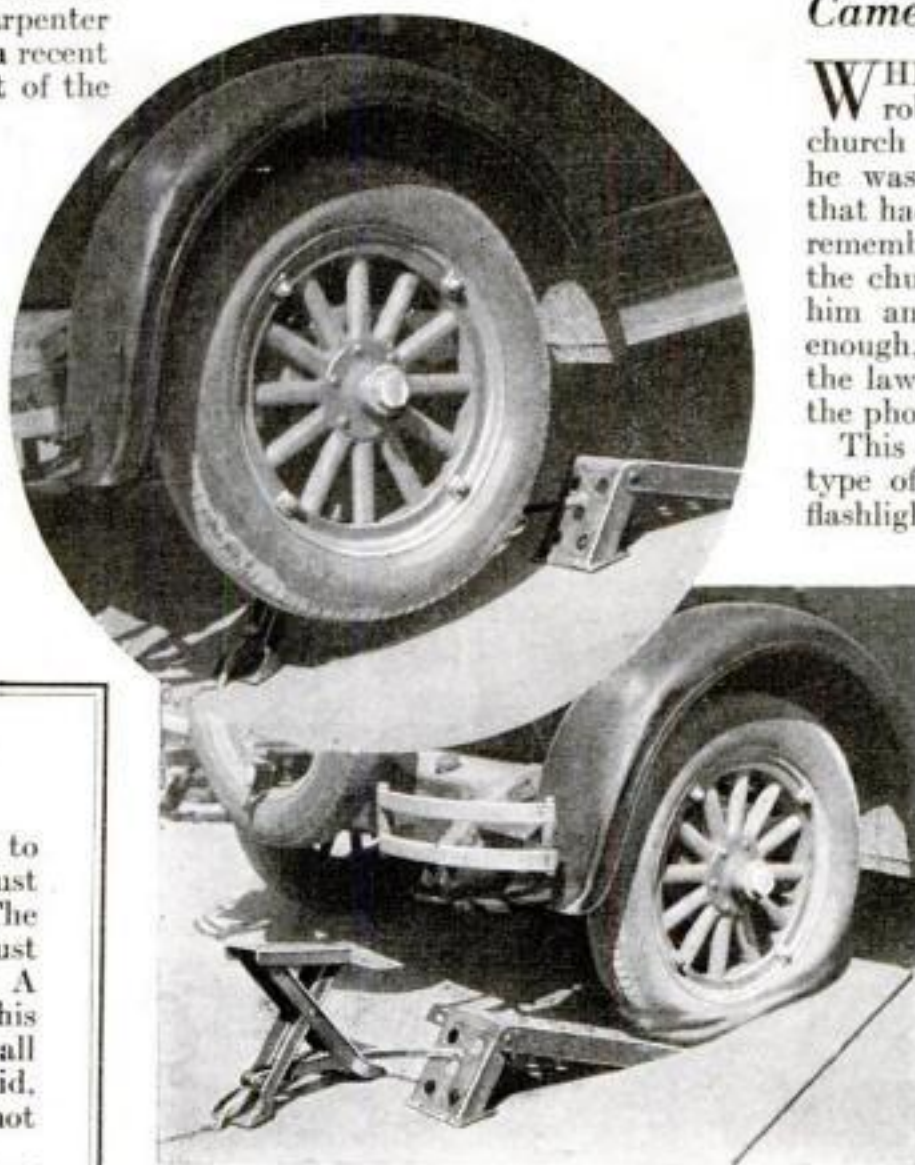
The danger of a rear-wheel skid is greatly decreased if the power is shut off and the car allowed to coast over the wet spot. If you find yourself approaching a wet spot, particularly on a turn in the road, at a speed that may result in a skid, apply the brake vigorously before you reach the spot and then take your foot off the brake pedal while you coast over the dangerous area. If the car starts to skid, immediately turn the front wheels to head in the direction of the skid.

Device Lets Driver See High Traffic Lights

THIS device was developed by a Cleveland inventor for the benefit of motorists who have to squirm about and crane their necks to see overhead traffic lights. It consists of a small lens which is attached to the windshield in front of the driver. This deflects the light rays at the exact angle necessary to enable the driver to see the reflected traffic signal without twisting himself into an awkward position. An optical expert made the lens to deflect rays as desired, just as he would a spectacle lens, and the driver can watch for his "stop" or "go" sign while sitting at his ease.



A deflecting lens for the motorist that brings a high traffic signal into his line of vision, as is indicated by the dotted lines in the picture.



New Jack Saves Work for Motorist

THE automobile instead of the driver does the work in using this new jack, consisting of a runway and a supporting table. A steel arm from the runway sets the supporting table in position to receive the axle when the car is run up and lowered to the table. To lower the car to the ground again, all that is necessary is to give a sharp jerk on the chain attached to the trip, which collapses the supporting table.

It is said the new jack will not tip over on soft or slanting roads. It folds into a compact box to fit under the seat cushions of the automobile.

Camera Catches Church Thief

WHEN Charles Callan, accused of robbing the poor box of a New York church not long ago, denied the charge, he was confronted with a photograph that had caught him in the very act. He remembered, then, a flash of light near the church's altar rail that had startled him and caused him to flee—not fast enough, however, to escape the arm of the law and a swift conviction based on the photograph's evidence.

This was the first actual test of a new type of detective camera that takes a flashlight picture of an intruder, also ringing an alarm. Its inventor had installed it in the church after repeated depredations on the poor box. Several other installations had been made in New York, including the booths at the entrance of the Holland tube, but this camera was the first to catch a thief. Following its successful trial, high police officials are reported to be considering its extensive use.

Chairs Ventilate This Auditorium

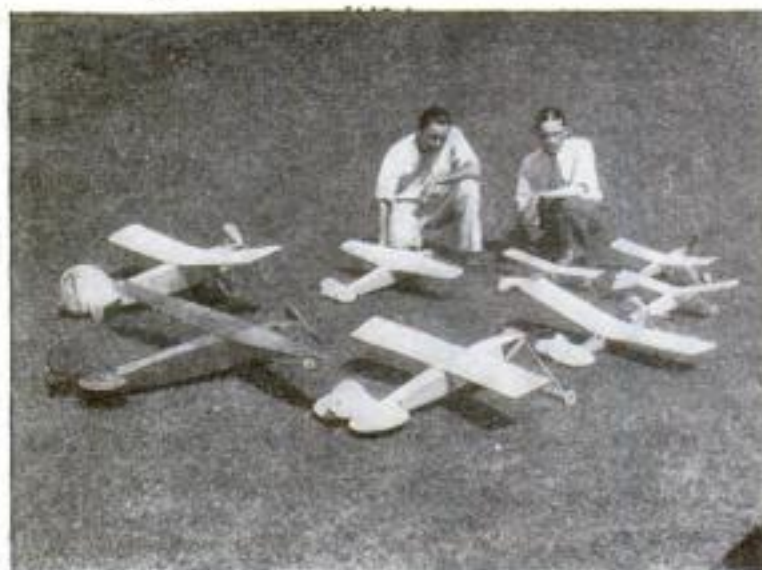
FRESH air is brought up through the legs of chairs into the auditorium of the Congressional Library, at

Washington, in a new ventilating system. Additional air to keep the millions of books free from brittleness or musty odors is washed with water and oil, to clean and humidify it, and blown through the shelves.

New Quick-Drying Varnish

A NEW varnish that dries thoroughly in four hours after it has been applied enables house painters and others to apply two coats in a single working day. Formerly a single coat required twenty-four hours to harden properly.

Boys Run a Miniature Plane Factory



Left: Oliver W. Young and Ralph E. Olson on the testing grounds of their model airplane factory in Los Angeles with eight machines which have just made their initial flights successfully.

Right: Oliver W. Young fitting a propeller to a half finished scale model of the *Bremen*, the famous German plane of the first westward North Atlantic crossing.



TWO Los Angeles boys, Oliver W. Young and Ralph E. Olson, have organized a miniature airplane factory in that city which is doing a thriving business. Besides their plant, they have their own "flying field" where "test pilots" try out the glistening machines as they come from the factory. With skilled hands they adjust the planes so that purchasers are assured of the maximum of speed and distance. The picture above shows Young and Olson on the testing field. Eight of the little airplanes which have been put through their paces and have proved satisfactory are lined up before them on the ground.

Both land and water planes are constructed. One of the large model seaplanes turned out by the factory is seen being launched by the builders in the lower photograph. Many of the planes are



Olson and Young, proprietors of the complete miniature airplane plant in Los Angeles, launching a seaplane model which they have just completed.

built to scale and exactly reproduce the characteristics of machines flown by famous pilots. These planes not only run along the ground and rise into the air under their own power, but some of them have made remarkable records in speed, distance, and duration flights.

A glimpse of the plant in which the little aircraft are born is given in the photograph at upper right. Young, seen in the foreground, is fitting a propeller to a half finished scale model of the *Bremen*, the famous German machine which made the first East-West crossing of the North Atlantic this year.

An innovation has just been introduced in one of the Los Angeles public parks where tiny hangars are provided for model builders to house their planes.

Vending Machine Says "Thank You"

THIS polite automaton, which has been placed in several parks in Berlin by a German newspaper, says "Thank you" when it delivers a paper after a coin has been dropped in the slot. A \$25,000,000 company has recently been formed in the United States to build similar automatons which are to be installed in cigar stores throughout the country.

Botanist Hunts Mate for Trees

A STRANGE story of the near extinction of a tree and its later revival is told by Dr. Edgar T. Wherry, of the U. S. Department of Agriculture, who is searching for a mate for it in order to write the last chapter of its history.

As long ago as 1765, John Bartram, early American botanist, discovered a small patch of the ornamental trees called *Franklinia*, after Benjamin Franklin, growing wild near Fort Barrington, Ga. Shortly after, a number were transplanted to Philadelphia. Only one survived and meanwhile the Georgia trees disappeared. For the last fifty years botanists have found no trace of them or of what happened to them. Only cuttings taken from the lone survivor by florists perpetuated the species; all the *Franklinia*



A machine that gives you a paper for a coin in the slot and then says, "Thank you."

trees in the world are believed to be the descendants of this single one.

Now Dr. Wherry seeks another *Franklinia* of independent ancestry, perhaps growing wild in some odd spot, that he can mate with the cultivated variety to breed new hybrids.

Machine Counts Phone Calls

BOUNCING balls of steel go mathematicians one better in a counting device recently exhibited in London by the Royal Society and used in telephone traffic estimates. Hitherto it has been a laborious and time-wasting process to calculate in advance the number of telephone calls and their routing that might be expected by a new telephone exchange. It was to obviate this that the "mechanical guesser" was devised.

Thousands of the balls, about the size of bicycle ball bearings, each represent an imaginary telephone call. They are made to bounce from a plate into a series of small holes arranged like those of the old-time game of bean bag. Each hole represents a different type of phone call, and the flying balls bounce into one or another in strict accordance with mathematical laws of probability. Merely by counting the balls that have fallen through each hole, a speedy analysis of expected telephone traffic is made that replaces tedious computations.

Army Demonstrates a New Gas Mask for War Horses

BUDDY, an Army horse stationed at Governor's Island, New York, is shown wearing the latest mask designed to protect war horses and mules during gas attacks. The bag of the mask fits tightly over the nostrils of the animal and is held in place by straps buckled over its head. Buddy demonstrated the effectiveness of the new protection recently when he carried Sergeant Joseph Levin, of the Chemical Warfare Service, through a deadly screen of poison gas without suffering ill effects. Levin is seen wearing the newest equipment developed by Army experts to protect soldiers.



Buddy, a U. S. Army war horse, and Sergeant Joseph Levin of the Chemical Warfare Service wearing latest masks against poison gas.

Machine Makes Plant Movies

THE strange machine at the right is a combination eight-day electric clock, powerful microscope, and moving picture camera. Set it and leave it alone for eight days and then you can take out a film that shows the development of a flower! Besides filming the growth of plants, the new machine is expected to catch the life history of germs and even to show on a strip of film the development of a chicken within the egg.

The apparatus is the invention of Carl D. Clarke, a medical illustrator at the University of Maryland, who is seen adjusting his machine. A strong light plays upon the under side of the subject to be photographed and the camera, directed through the microscope, takes pictures at a rate governed by the electric clock. Much of the drudgery which has attended the filming of slowly developing objects is expected to be eliminated by the invention.



The combination clock, microscope, and camera that without any attention makes an eight-day motion picture of a growing plant.

Beating Heart Is Filmed

WHEN a heart beats, contractions sweep over it in successive waves, from top to bottom. This was shown in slow motion pictures recently made of the heartbeats of an anesthetized animal by Dr. L. B. Arey, Professor of Anatomy at Northwestern University Medical School, Chicago. The pictures were first run at the normal rate of beating and then slowed down so that students could observe the successive stages of each pulsation of the heart.

The Sun's Flames Measured

FLAMES leap outward from the surface of the sun at a rate of 20,000 miles a minute and sometimes reach a height of half a million miles, according to Dr. Ferdinand Ellerman, of Mt. Wilson Observatory, in California. When these "prominences" were first noted, during a complete eclipse, early astronomers were divided as to whether they belonged to the sun or the moon. In 1868, Sir J. N. Lockyer, English astronomer, found he could observe them by a spectroscope without waiting for an eclipse and proved that they issued from the sun. It was while studying these tongues of flame that he became convinced of the existence of helium, the gas now used to lift Navy dirigibles, including the *Los Angeles*.

To Cross Ocean in 50 Hours

A 2,400-HORSEPOWER speed boat that will be able to cross the Atlantic from Brest, France, to New York in fifty hours, according to the claims of its designer and builder, is being constructed by Ettore Bugatti in his automobile plant at Molsheim, Alsace.

The 115-foot craft, a model of which is seen below, will have six forward and two reverse motors and will be capable of a maximum speed of eighty-seven miles an hour. In rough weather it can be navigated with all hands below deck. At such times a special ventilation tube system devised by the inventor will be in operation, supplying fresh air to the crew.



In the eight-motored boat of which this is a model, Ettore Bugatti declares he will cross the Atlantic in 50 hours.

Inventor Claims a \$25 Home Talking Film Outfit

NEW bits of comment gleaned from the movie world discuss the latest aspect of "talking movies," whose threat to invade a field long reserved for the silent drama was described last month in *POPULAR SCIENCE MONTHLY*.

Amateur talking movies in the home are a possibility frequently mentioned. A California inventor claims a home "talkie" making outfit used with a phonograph, that can be made for \$25, resembling the old-time synchroscope first tried commercially as a maker of sound pictures. Non-inflammable films of treated paper and new inexpensive projectors are seen as aids to home "talkies". With the great movie companies, "talkies" are introducing new production methods. One concern is using a Camden, N. J., church in preference to its own studio by reason of its perfect acoustic properties.

Color Device Grades Cotton

A SENSITIVE new colorimeter, devised by Dorothy Nickerson, of the U. S. Department of Agriculture, instantly grades hay, cotton, and other materials according to their color and does away with the necessity of more complicated tests. The field of the eyepiece of the instrument has two halves. One gives the color of the material being examined. In the other a color chart is whirled until the matching shade is reached.

Strange Facts About Sleep

MEN behave like vegetables for a third of their lives, according to Dr. H. M. Johnson, psychologist at the University of Pittsburgh. When men are asleep, he says, they do nothing, know nothing, enjoy nothing. They are in a similar state to that of vegetables. However, he points out, few people sleep soundly for more than a few minutes at a time. Examination of twenty-two college men showed that they moved in their sleep on an average once every thirteen and a half minutes.

Plates Fitted to Your Car

NO LONGER is it necessary to mutilate license plates to make them fit the brackets on your car, according to Ray M. Hudson, of the Department of Commerce's commercial standards division. Plates in every state now conform to standard bracket slots proposed by the Society of Automotive Engineers.

Auto Bumpers Standardized

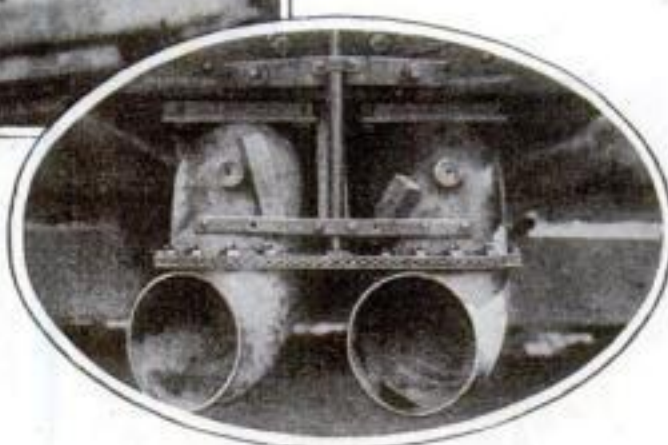
A RECENT survey at Washington, D. C., reported in a bulletin of the U. S. Bureau of Standards showed that locked bumpers were a more serious cause of traffic tie-ups than any other single trouble; and the first step toward a remedy has been taken with the drafting of a uniform code for motor coaches providing for a standard bumper height so that in the event of minor collision the bumpers will meet face to face.

Water Jets May Drive Ships Through Ocean



Left: Virgil C. Anderson explains the mechanism of an 18-foot model of the liner he proposes to send across the ocean by water jet propulsion.

Below: The two nozzles at the rear of Anderson's boat which he says will drive it forward at high speed, expelling water taken in at the front.



OCEAN liners, without propellers or rudders, pumped through the water at the rate of 100 miles an hour, are the plan of Virgil C. Anderson, of San Francisco. Anderson, who was in the submarine service during the war, believes that two twenty-four-inch pistons with a six-foot stroke, working in cylindrical pipes, drawing in water and expelling it under high pressure from the rear, would drive the vessel across the Atlantic in less than three days.

The nozzles through which the water is expelled are designed to move from side to side under control of the pilot and thus steer the vessel.

Packing Cases Box Car Size

HUGE shipping boxes that transform a railroad flat car into a sectional box car have recently been tried in Great Britain to meet the growing competition of automobile trucks as freight carriers. They dispense entirely with the tedious process of loading and unloading a standard box car.

At a factory, goods to be shipped are packed in one of these giant containers, which is then transported by truck to the railroad freight yards. A crane hoists the gigantic box upon a flat car. On reaching the town of its destination the container is swung off by another crane and transferred to a truck for the remainder of its journey.

The method is said to facilitate packing, and to minimize loss by breakage or theft and is credited with becoming an instant success.

A Mechanical Census Clerk

THE remarkable machine at the right, which turns out as much work in one minute as a human clerk can do in six hours, will help Uncle Sam tabulate the census of 1930. It is shown being tested by an employee of the Census office in Washington, D. C. The machine puts down sixty facts on cards by punching holes in them to indicate the answers to questions. Then it sorts the cards and finally adds up the totals, never making a mistake.

Autos Halted in Five Feet

SPEEDING cars are stopped instantly at the will of the driver through "wheel chocks," new substitutes for automobile brakes, according to claims of the inventor, Pasquale Strano, of Elizabeth, N. J. They are said to have brought a light car moving twenty miles an hour to a halt in less than five feet without damage to the automobile or shock to the driver.

The new mechanism stops any car by dropping eight-pound wedge-shaped shoes under the rear wheels. Rocker arms, integral with the car's chassis, guide the shoes, which have a cork tread to prevent skidding. It is impossible for the wheels to pass over the chocks, which have rollers on their top surfaces allowing the wheels to revolve freely without moving the car if power is applied before the unique brakes are released.



The machine that does six hours work of a clerk in a minute. It puts holes in cards to indicate answers to census questions.

"Televox" Acquires Voice; Mechanical Man Uses Phone

NOW "Mr. Televox," the East Pittsburgh, Pa., automaton created by Roy J. Wensley, Westinghouse engineer, has a deep bass voice. A mechanical man with electric coils for muscles and a newly-added strip of "talking movie" film for lungs, he is able to acknowledge a call vocally and even to put one through on his own account if necessary.

Not a laboratory toy is Televox, previously described in *POPULAR SCIENCE MONTHLY* in his first voiceless form; but an intensely practical electric watchman over distant power sub-stations, where he replaces a regular attendant. When his telephone number is dialed he picks up the receiver and replies, "This is Televox speaking from Randolph 6400." Conversation with him is carried on by blowing whistles of different pitch; each one asks a certain question, to which Televox replies in buzzer code. For instance, he can report the height in feet of the water in a reservoir.

Televox has another speech that he makes in English. In case of trouble in a power station, he can call the distant dispatcher himself by lifting the telephone receiver and saying to the operator, "Televox calling for Atlantic 9000." Then, again through the whistle-and-buzzer code, Televox can tell the dispatcher what has gone wrong and receive orders as to what to do. Very often Televox himself can save the dispatcher a personal trip, as by closing a circuit-breaker that has opened.

Politics Spurs Inventors

EVEN the U. S. Patent Office plays a part in the presidential campaign. It has been swamped by applications of inventors and manufacturers of advertising specialties to boost one candidate or another. New designs for buttons, banners, and auto windshield stickers, even for cap bands are among the many novelties received.

Manuscript Ages Old Saved

A MYSTERY more than thirty centuries old was solved recently in England with the help of modern chemistry. For fifty years, an ancient Egyptian manuscript had lain in the British Museum unread. The leather roll had become so brittle that no one dared open it. In the museum laboratory, chemists examined a tiny fragment and discovered a way to soften the leather. Thin coats of celluloid were soaked into the pores and then the leather was carefully cemented to celluloid-treated cheesecloth. In this way it was unrolled safely and pressed flat between two glass plates to dry. Afterwards it was read with ease.

Film Showing Color Shades Here for Amateur's Camera

AN IMPROVED film for the use of amateur photographers has recently been put upon the market by a British concern. It is known as panchromatic, or equally color-sensitive film. It should not be confused with the new Eastman color movie film, described elsewhere in this issue. It does not take color pictures but it shows correctly the lightness and darkness of any color, including red. Ordinary film, as every old-time snapshotter knows, records red lips as black, and a light blue dress as white, due to its abnormal preference for blue light—a preference partly corrected for most colors, but not for red, in the so-called orthochromatic films, now widely used.

For perfect results with the new film a light yellow screen of transparent glass or gelatin is placed before the lens while the picture is taken. In strong light, instantaneous snapshots are possible. The usual red lamp cannot be used in the developing room and the film is developed in a faint green light or in total darkness.

Panchromatic dry plates and motion picture film have been available for several years. Only now has film of this type been supplied for amateur use for roll-film and film-pack cameras.

The Safe Way to Wash Silk

THE life of silk depends upon how it is washed, says the Bureau of Home Economics of the Department of Agriculture. Wash silk garments in lukewarm water, never in hot. Do not rub hard or twist the fabric. Rinse thoroughly in water the same temperature as that of the washing and remove the water by squeezing and patting the silk between dry towels. Never dry silk in the sun. To keep pongee silk from spotting, iron it dry. Silk hose should never be ironed.

Gas Kills Boll Weevils

CREATING a cloud of poison smoke, a machine guided by a driver wearing a gas mask moves across a cotton field, exterminating the boll weevils as it goes. Poison dust is fed from a hopper into a small fire box from which a fan forces the heavy, gaseous smoke into a tentlike inclosure that prevents its being dissipated before it reaches the ground.

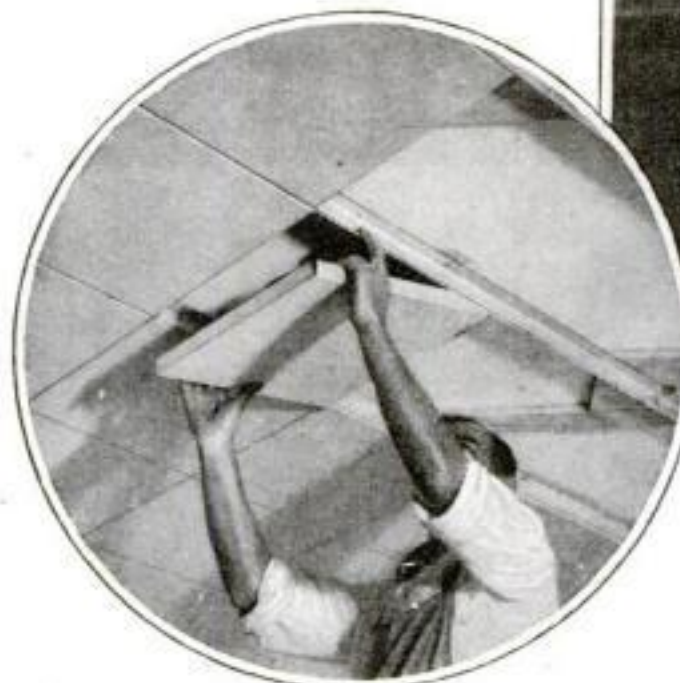
As the team moves along the rows, the weevils fall to the ground and "play possum," and the poisonous smoke descends upon them before they can escape. The inventor of the apparatus, A. B. Camden, of Oklahoma, says a single exposure to the deadly smoke cleans the weevils out of a field and that the cost of operation is only twenty cents for each acre treated.



Driven through cotton fields, this machine puffs out poisonous smoke that is said to kill boll weevils at a cost of 20 cents an acre.

Soundproof Tiles Reduce Factory Din

TILES which absorb sound have been developed by engineers of a Chicago laboratory. They are made of metal in the form of trays, sixteen inches square, perforated so that sound passes through them just as it does through a screen window. The trays are packed with a feltlike, sound-absorbing material which is said to consume seventy percent of the noise that reaches it through the perforations. The tiles, fitted into steel sections, lock rigidly together. They come with a white enameled surface to which patterns may be added if desired. They are designed primarily for factory and office ceilings.



Seventy percent of the sound that goes through this perforated ceiling tile for soundproofing offices and factories is said to be absorbed by the feltlike filling. Left: A workman locking ceiling tiles in place.

When Metal Gets Tired

A METAL gets tired and needs a rest the same as does an animal, says Prof. J. B. Kommers, expert on metal fatigue at the University of Wisconsin. When an axle breaks or an automobile wheel drops off without apparent cause, the reason usually is that the metal was fatigued and needed a rest and didn't get it. There is no way of preventing this fatigue except by resting the metal. Experiments have been carried out at the Massachusetts Institute of Technology in photographing metals with the X-ray to determine if they are tired.

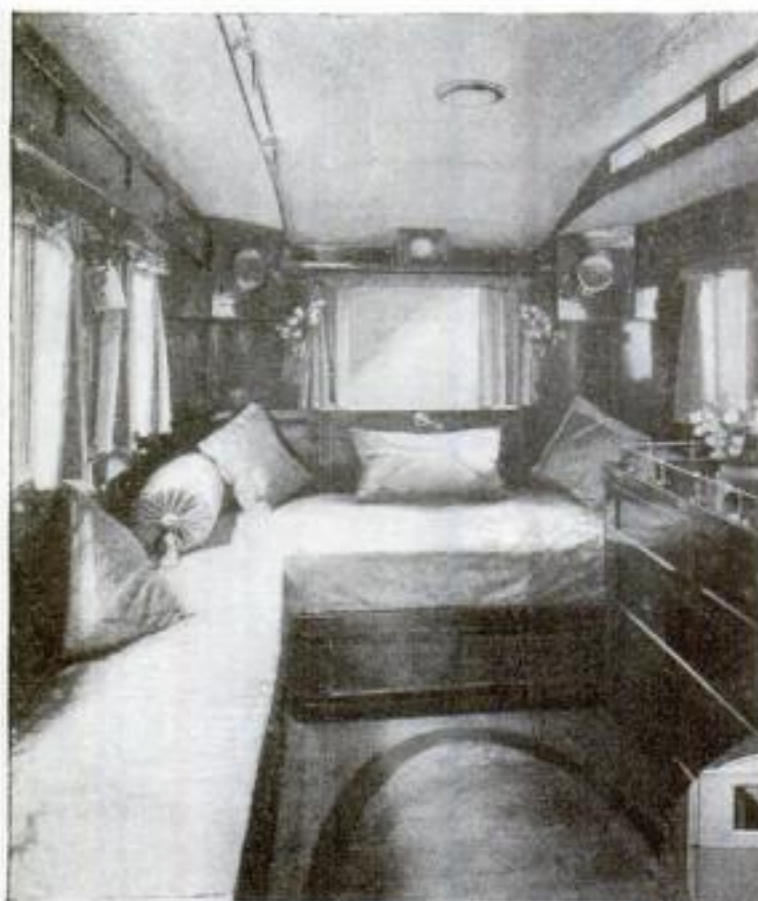
Skyscraper Sets Speed Mark

IT TOOK a crew of fifty men just thirty-six working days to erect the steel framework of a twenty-five-story Chicago building, setting a new speed record for construction jobs of that great size. As the building rose to its final story, a fifteen-ton derrick helped swing the steel columns and beams into place. Speedy delivery of steel to the site of the new building and accurate fabrication at the shop supplying it helped in making the remarkable record possible.

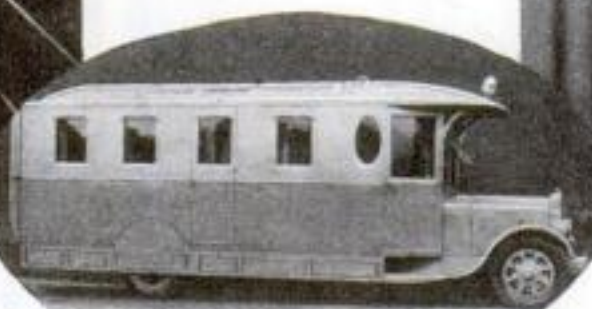
Asks Elevated Auto Exhausts

AUTOMOBILE motor exhausts should be on top of cars instead of near the ground, according to Dr. Louis I. Harris, formerly Health Commissioner of New York City, who has suggested the change to several manufacturers as a means of reducing the amount of carbon monoxide breathed by city dwellers. If this gas were expelled above the heads of pedestrians, he says, it would continue to rise and cause little trouble, because it is slightly lighter than air.

Big New Automobile Built Like a Luxurious Yacht



At the left is a view of the luxurious, light and airy saloon of the four-room motor "yacht" on wheels, showing upholstered couches, sideboard, and many conveniences. At the right is seen the tiled bathroom complete with its lavatory and shower. Below is an exterior view of the graceful 24-foot car built for a Rocky Mountain hunting trip. Underneath it carries a storage refrigerator for food supply.



OUTFITTED like a luxurious sea-going yacht, this motor vehicle, called a "Flatavan," built by an English engineer for an Easton, Maryland, sportsman, who will make a hunting trip to the Rockies in it, can speed along at forty-five miles an hour. The van has four compartments, a lavatory with a shower bath, a saloon, a kitchen, and a driving compartment. The searchlight fitted to the roof has a range of a mile and will aid in mountain driving. The weight of the land yacht is more than four tons. Its length is twenty-four feet and its width is seven feet and a half. Beneath the body, besides the gasoline and water tanks, is an ice chest and a large refrigerator where provisions can be kept fresh.

Auto Seats Made Into a Bed

IN THE "Pullman-sedan" seen below a few simple motions will adjust the front and rear seats to provide a comfortable bed for the night. Tourists, says the inventor, may park anywhere nightfall finds them and sleep as restfully as they would in a hotel.

A \$5,000 Duck

A DUCK valued at \$5,000 was recently exhibited at the Field Museum of Natural History in Chicago. It was a specimen of the extinct Labrador duck, said to be rarer than the famous extinct great auk. Only 45 specimens exist in the whole world, according to Dr. Wilfred Osgood, curator of zoology at the museum. The bird formerly inhabited the north-eastern coast of America. About fifty years ago, it suddenly disappeared and since then not a single living specimen has been seen.



Better than a stuffy Pullman berth is this "Pullman-sedan" touring car, whose front and rear seats are adjusted to make a comfortable bed. Independent of hotels, he can park for an airy sleep anywhere along the road.

The Rainiest Spot on Earth

THE world's wettest farm lies on the Gulf of San Blas in Eastern Panama. Known as San Blas Farm, it is the headquarters for a large banana plantation. In three months, the rainfall there totaled 137.12 inches—three times as much as is usually recorded in Washington, D. C., in a year.

There is no place in the world, meteorologists say, where rain does not fall at one time or another. Even in deserts it rains occasionally, although in many regions showers are brief. It is said a Yuma, Arizona, hotel displayed for years a large sign reading: "Free meals every day the sun does not shine." No free meals have been served in the fifteen years the sign has been up, because rain came only in short showers with sunshine between.

Shorthand Sent by Telephoto

SENDING shorthand messages by wire is the latest application of the telephotograph. A picture, accompanied by a hundred-word message written in shorthand explaining it, was recently sent from the telephotographic station of the American Telephone and Telegraph Company in New York City to Los Angeles in about seven minutes. Officials of the company say as many as 2,500 words can be sent over the wires in a single transmission by using shorthand. The limit for an ordinary typewritten message, sent as a single picture, is 800 words.

Insects Poison and Stab Ants

AN ASSASSIN insect in the Dutch East Indies that poisons and then stabs its victims has been observed by the British entomologist, W. E. China. It is a distant relative of the cicadas and expels a poison fluid that attracts a certain species of black ant. Eating it, they are paralyzed, and the bug then stabs them and drinks their life blood. When it leaves, another species of ant, a red one, feasts upon the remains of its relative.

Any Questions?

THIS magazine is always very glad to answer readers' questions regarding subjects within its field, and to supply names of manufacturers of articles mentioned in its columns. Inclose stamped, self-addressed envelope and write to Information Department, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York City. Replies are made as rapidly as possible, though the necessary research may take a considerable time.

Trees Grow by spurts for Forty Days of Each Year

NINETY percent of the height growth of trees in the latitude of Pennsylvania is attained during forty days in spring and early summer, according to an investigation reported by the American Tree Association. This contradicts the belief, held for many years, that trees grow steadily from the time they put out their leaves in the spring until the frost comes in the fall.

Automobile a Sun Bath House

NOW devotees of the open air can take a sun bath any time in complete privacy whether they are in a city's midst or touring along an open road. A new English automobile, outwardly resembling a standard sedan, is equipped with a demountable top that can be rolled back completely to admit the sun. At the same time opaque curtains may be drawn across the windows and the glass panel behind the driver's seat, thus completely screening the occupants from outside view while the sun beats down upon them from above.



Warns When Tail-Light Fails

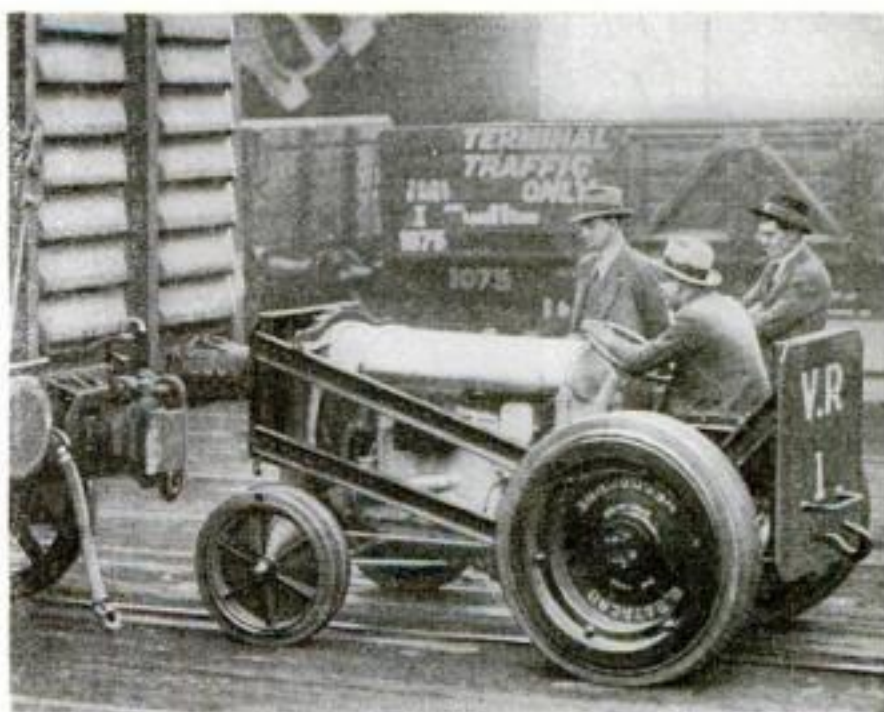
OWNERS of cars equipped with this novel device, invented by a French mechanic, need not get out and walk around to the back to see if the tail-light is on. The tiny indicating lamp fits on the dashboard and is dark as long as the tail-light is functioning properly. As soon as the circuit is broken at the tail-light, the dashboard light flashes a warning to the driver.

Clock a Glacier's "Diary"

THE "diary" of a glacier, covering seventeen years, has recently been made public by Prof. R. T. Chamberlin, of the University of Chicago. Lines scratched by two needles on a clock-driven disk kept the record and proved a theory of glacial movement advanced thirty years ago by Prof. Chamberlin's father, a noted geologist. The record showed that the ice fields move forward with spasmodic jerks as stress accumulates, and not smoothly, as was once the general supposition.

Tiny Tractor Moves Huge Railway Cars About

THIS sturdy little American tractor at work on Prince's Pier, Melbourne, Australia, has taken the place of horses which have been used for years to shunt railway cars about the tracks leading to and from the ships. The tractor pulls the cars behind it by a hook attached to the back or pushes them before it with a heavy steel bumper braced in front of the radiator.



American efficiency has driven the horse from Prince's Pier, Melbourne, Australia, where this sturdy tractor pushes and pulls railway cars to points where loading and unloading are most convenient.

Test Burning of Matches

EVERY year \$100,000,000

worth of property goes up in flames in the United States because matches burn too long. That is the conclusion drawn from a recent series of experiments carried on in Washington, D. C., by the Bureau of Standards. The average length of time required to light a pipe or cigarette was found to be ten seconds. The stick of a match burns an additional twenty seconds.

A million matches a minute, it is estimated, are used in the United States. Many of these start fires after they have been thrown away. The experimenters found that special matches, with water glass coating the sticks up to half an inch of the heads, burned only half as long as ordinary ones; and while proving as effective for lighting purposes, they were generally consumed before they could set fire to surrounding grass or rubbish. When dropped from a height of three feet, matches, whether coated or not, ignited grass in fifty percent of the trials.



This baseball catcher's mask is free from the crossed wires of the old style, so it need not be thrown off in order to make a difficult catch.

Building Highest Dam

THE highest dam in the world is being constructed in the Owyhee River in eastern Oregon, near the Idaho line, under the direction of the Bureau of Reclamation, Department of the Interior. Nearly half a million cubic yards of concrete will be used by the Seattle, Washington, contractors. The dam will be 520 feet high from the lowest concrete in the foundation to the top and its thickness will begin with thirty feet at the top and increase gradually until the maximum of 265 feet is reached at the bottom. A tunnel twenty-two feet in diameter and 1,005 feet long, cut in the form of a horseshoe through the stone of the canyon wall around one end of the dam, will be a preliminary step to divert part of the water and facilitate work on the main parts of the structure.

Mask Clears Catcher's Vision

IF A foul tip crashes into the new catcher's mask, seen at the left, the player is completely protected. At the same time, the elimination of vertical wires in the construction insures him an unobstructed view of all parts of the field. This improved mask made its appearance when "Bubbles" Hargrave, of the Cincinnati "Reds," introduced it to major-league baseball.

Recording National Dialects

BEFORE good roads and the radio wipe out dialects in the United States, Columbia University is going to record permanently on phonograph records the characteristic speech of different sections of the country. The university has set aside \$500 for this purpose. The same "bedtime" story, about a rat that came to an evil end, will be read into the recording apparatus by each speaker. This story, written by Dr. Hans Kurath, of Ohio State University, embodies words whose pronunciations most strikingly show the differences in the various dialects of the country.

Popular Science MONTHLY



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When Telephones Were "Impossible"

SIXTY-ONE years ago, a Boston newspaper published this editorial:

"A man about 46 years of age, giving the name of Joshua Coppersmith, has been arrested in New York for attempting to extort funds from ignorant and superstitious people by exhibiting a device which he says will carry the human voice any distance over metallic wires so that it will be heard by the listener at the other end.

"He calls the instrument a 'telephone.' This is obviously intended to imitate the word 'telegraph' and win the confidence of those who know of the success of the latter instrument without understanding principles upon which it is built.

"Well-informed people know that it is impossible to transmit the human voice over wires as may be done with dots and dashes and signals of the Morse code, and that, were it possible to do so, the thing would be of no practical value."

There are still people who are as ludicrously skeptical of the accomplishments of the photo-electric cell of which Doctor Free writes in this issue. Fortunately they are few.

Radio May Need Policing

AN INTOLERABLE radio situation has been suggested by a recently demonstrated device enabling listeners to make their receivers function as miniature transmitters. The idea is not new. Several years ago it was demonstrated that speech directed into the speaker of a large set might be heard in the speaker of a near-by smaller set. But if put into practice it undoubtedly would be offensive to the vast radio public. It has the possibility of affecting not only every near-by set, but the wave of the broadcaster to which it is tuned. Operation of such a device should call for immediate action on the part of the Federal Radio Commission under the act prohibiting unlicensed broadcasting.

Great Ideas Are Simple Ones

BECAUSE an idea is obvious, it doesn't follow that it isn't patentable. Our patent laws reward the man who really solves a problem; not the man who, after its solution, thinks he could have solved it. So ruled Chief Justice Martin of the District of Columbia Court of Appeals in connection with an application covering the freezing of a stick into a block of ice cream.

Great ideas are simple ideas. The other day, a man told us about an invention which had proved to be worth thousands of

dollars to industry. It was based upon a new way of piling up tin pans!

The most useful inventions have been simple ones. The lever, the wheel, the safety pin, are examples. Perfecting a machine usually means simplifying it. Mr. Eastman, in whose laboratories was developed the new color process for home "movies" described on page seventeen of this issue, advertised, "you press the button and we'll do the rest." And when Orville Wright finished his triumphal flight at Fort Myer, he said: "Now that we have shown the airplane is practical, we will try to make it simple."

Why Architects Should Marry

BRITISH psychologists have undertaken to find out why housework tires out more people than any other job in the world. Dr. C. S. Myers, of the National Institute of Industrial Psychology in London, would design houses to save needless steps and would use every possible scientific convenience.

Experts have effected enormous savings in time, energy and health in offices and factories. Undoubtedly they can perform equally valuable service in the home. As in industry, however, the final solution will be found in invention. And it might help if no architect designed a home until he married and realized the value of his wife's opinion of his plans.

What Is the Speed Limit?

A READER recently asked us to tell him the ultimate speed limit at which human beings can be transported. We don't know. Two things govern it—the ability of the human organism to withstand acceleration and the ability of machines to accelerate. Automobiles have been driven at more than 200 miles an hour; airplanes at more than 350 miles—half the speed of sound. Nobody knows yet how much speed the human body can stand, but both the body and machines seem capable of greater speeds.

We do know, however, that a machine's speed limit always will be determined by the distance between stops. The machine of the future will accelerate, or "pick up," at the greatest speed the passengers can stand. This rate of acceleration will be maintained for half the distance to be traveled. Then, of necessity, the machine must decelerate, or "put on the brakes," for the remainder of the distance. The greatest speed will be reached midway between stops, and the greater the distance, the greater the possible speed. An automobile, for example, accelerating at the rate of a mile an hour each second could travel across the United States in less than two hours. Fascinating speculation, isn't it?

They Are Saying—

"TRAFFIC signs and signals should be made so simple and so uniform that guiding an automobile would become as automatic as walking."—Dr. Knight Dunlap, Professor of Psychology, Johns Hopkins University.

"Most of our present habit of training children is too laborious with too many don't's."—Dr. Mandel Sherman, Director, Washington Child Research Center.

"Illness costs each family in the United States \$134.68 annually, a per capita cost of \$31.08."—Dr. Homer Folks, Member of the New York State Public Health Council.

"Chemistry can now make an excellent reproduction of almost any precious stone, and do it so faithfully that none save the most expert and practiced eye can tell the difference."—Dr. Frank B. Wade, former President, Indiana Academy of Science.

"It costs the average motorist \$1 a day to run his car—\$229 a year for maintenance, and \$136 for depreciation."—American Motorists Association.

"Use of electrical energy and machinery bring upon the present and future generations the problem of what man should do with his leisure."—Dr. George Otis Smith, Director, United States Geological Survey.

"No State can tax as income royalties received by one of her citizens for the use of patents issued to him by the United States."—The United States Supreme Court.

"I'm safer under the sea than my wife is trying to cross a busy street."—William Wickwire, S-4 deep-sea diver.

"Genius of a certain type may be commoner among Italians than among Swedes, and as a result of the crossing of these two peoples a type in many ways finer than either may be produced."—J. B. S. Haldane, English Biologist.

These Leading Aircraft Manufacturers Have Selected "The Highest Priced Bearing in the World"

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AIRCRAFT DEVELOPMENT CO.	Dirigibles
ALLISON ENGINEERING CO.	Motors and Accessories
ARMY AIR SERVICE	Planes and Motors
BELLANCA AIRCRAFT CORP.	Planes
BROWNBACK MOTOR LABORATORIES	Anzani Motors
CONSOLIDATED AIRCRAFT CORP.	Planes
CURTISS AEROPLANE & MOTOR CO.	Planes and Motors
DAYTON AEROPLANE ENGINE CO.	Motors
EBERHART AEROPLANE & MOTOR CO.	Planes and Accessories
ECLIPSE MACHINE CO.	Starters and Generators
FAIRCHILDS AIRPLANE MFG. CO.	Planes
FAIRCHILDS-CAMERA CORP.	Aerial Cameras
FAIRCHILDS-CAMINEZ ENGINE CORP.	Motors
FISHER & JACOBS	Motors
FLOCO—F. L. ODENBREIT	Motors
T. L. FRAWICK	Reduction Gears
GENERAL ELECTRIC CO.	Accessories
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HAMILTON METAL PLANE CO.	Planes
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is apt to cost so much as a bearing that cost so little*

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A Piece of String Fixes an Auto

Gus and Joe Hire a Wizard Who Doesn't Bat an Eye at a Dead Battery or Broken Steering Arm

BY MARTIN BUNN

I WONDER how 'Spare Parts' Harbison made out with that queer little mechanic you talked him into taking on his automobile trip?" Joe Clark observed.

"Must have worked so well that 'Spare Parts' extended his trip to cover a lot more territory," replied Gus, who was Joe's partner in the Model Garage. "I wish they'd come back. We need another man right along. I'm thinking, and that little Alec McGregor ought to fill the bill."

"Maybe he will come back," argued Joe, "but I can't figure out how you know he's so good. You've never seen him do even one job."

"Just wait and you'll see," said Gus confidently.

"Guess I won't have to wait long," Joe chuckled as he saw a car drive up in front of the garage. "Here they are!"

"That certainly was one swell trip, Gus," said Harbison enthusiastically after the greetings were over. "Never had to worry about the car. Alec, here, is the real stuff. And the funniest thing about it was that we didn't have to use a single one of the spare parts we took."

WHAT! No trouble at all?" exclaimed Gus in mock surprise.

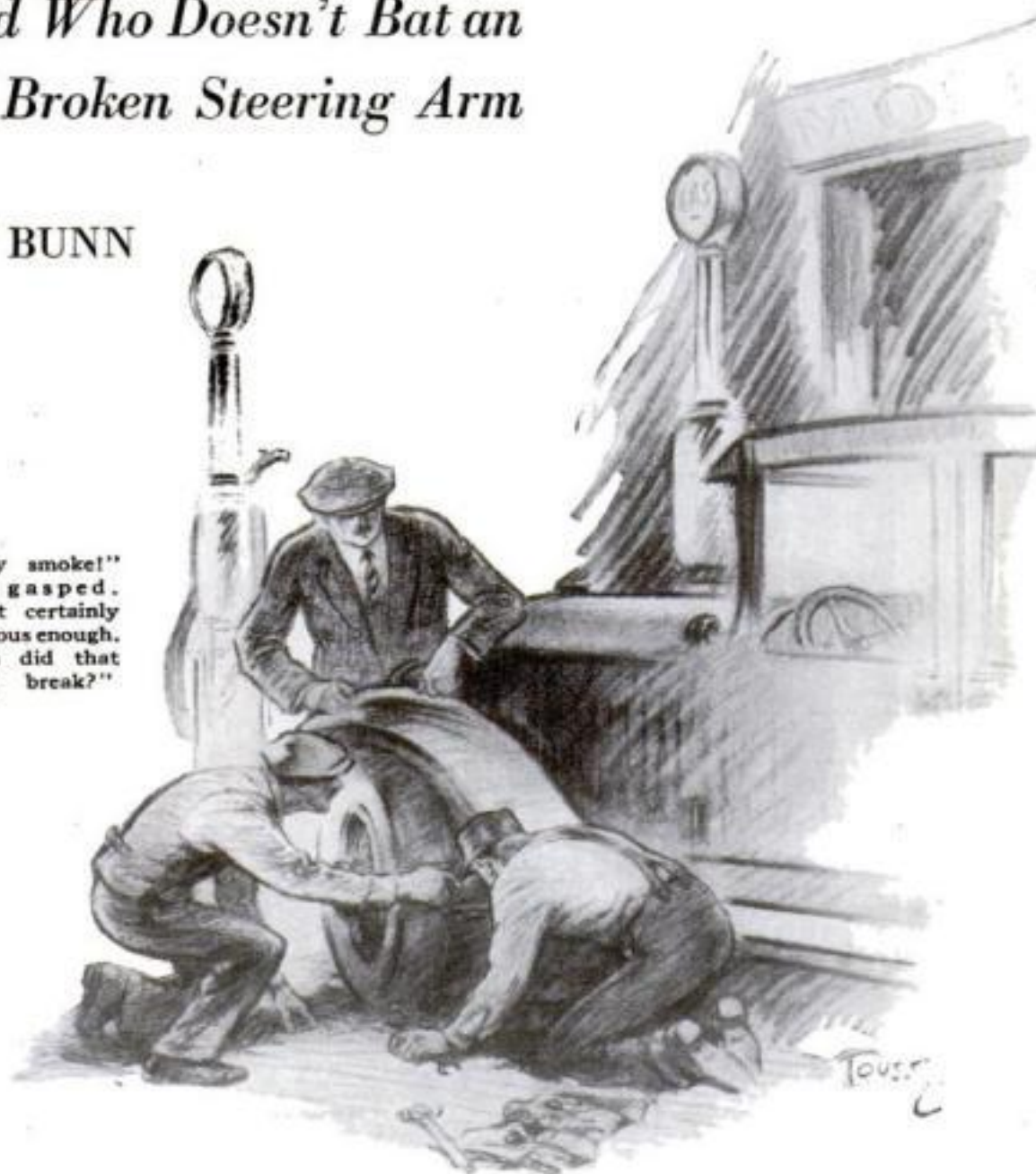
"Sure we had trouble. Lots of it!" Harbison replied. "Never had so many fool things happen on one trip. But Alec here is a regular wizard on that stuff. Nothing went wrong for the first week. Then one morning Alec suddenly began sniffing the air like a hound dog. Alec, you'd better explain what was wrong; I don't quite understand myself."

"Wasn't much," said Alec modestly. "I smelled scorched paint so we stopped and found the motor was boiling like a steam engine. Funny part of it was we could hear the steam gurgling around inside the cylinders but when I poked open the filler cap on the radiator with a stick so's not to get scalded with the steam, nothing came out. I figured the top water pipe must be stopped up some place and I took it off after the motor cooled a bit. It was all clear so I took off the thermostat. A piece of wood—don't know where it came from—had worked up in back of the valve and when the valve closed after we'd put the car away the night before, it had jammed it tight shut."

"I wouldn't have found that trouble in a million years," admitted Harbison.

"It probably wouldn't happen once in a million years," Gus commented. "You

"Holy smokes!"
Gus gasped.
"That certainly
is serious enough.
When did that
thing break?"



did well to find it so quick, Alec. Great!"

"The next trouble we had was sort of freakish, too," Harbison resumed. "We had to stop over night at a little inn up in the mountains and the next morning we found the storage battery stone dead. Alec found that the starter switch had partially shorted and drained every speck of juice out of the battery. There wasn't enough left to start the motor even with the crank. It looked like we'd be stuck until we could get another battery sent in, because there wasn't a battery charger or even any electric light current in the place and we couldn't find any door bell batteries. And there wasn't any other car to give us a tow to the nearest service station. But that didn't

feaze Alec. He noticed that there was quite a steep down grade in the road a couple of hundred feet from the inn. So we got behind the car and pushed it to the top of the grade.

ALEC threw it in high gear and after we picked up speed down the hill he let in the clutch. We were going fast enough so that the generator cut in and the needle moved over to charge. Just before we got to the bottom of the grade Alec threw the ignition switch and the motor started as nice as you please. You can bet we didn't let it stop again for several hours."

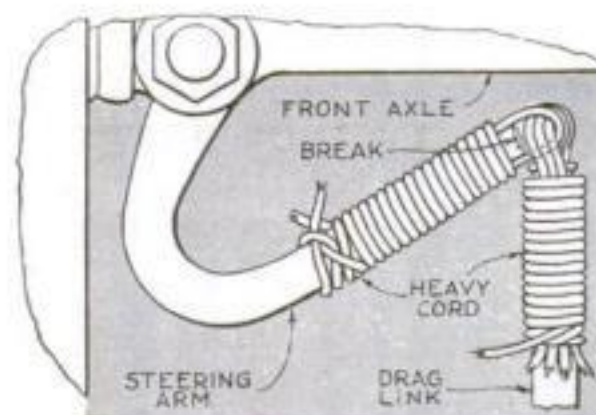
"Good work, Alec!" Gus approved. "But what would you have done if there hadn't been any grade to coast down?"

I GUESS we'd have been stuck," Alec promptly admitted.

"We had no trouble after that for nearly another week," Harbison continued, "and then came the queerest one of all. A tiny green worm succeeded in stopping this big, heavy car. Tell 'em how it happened, Alec."

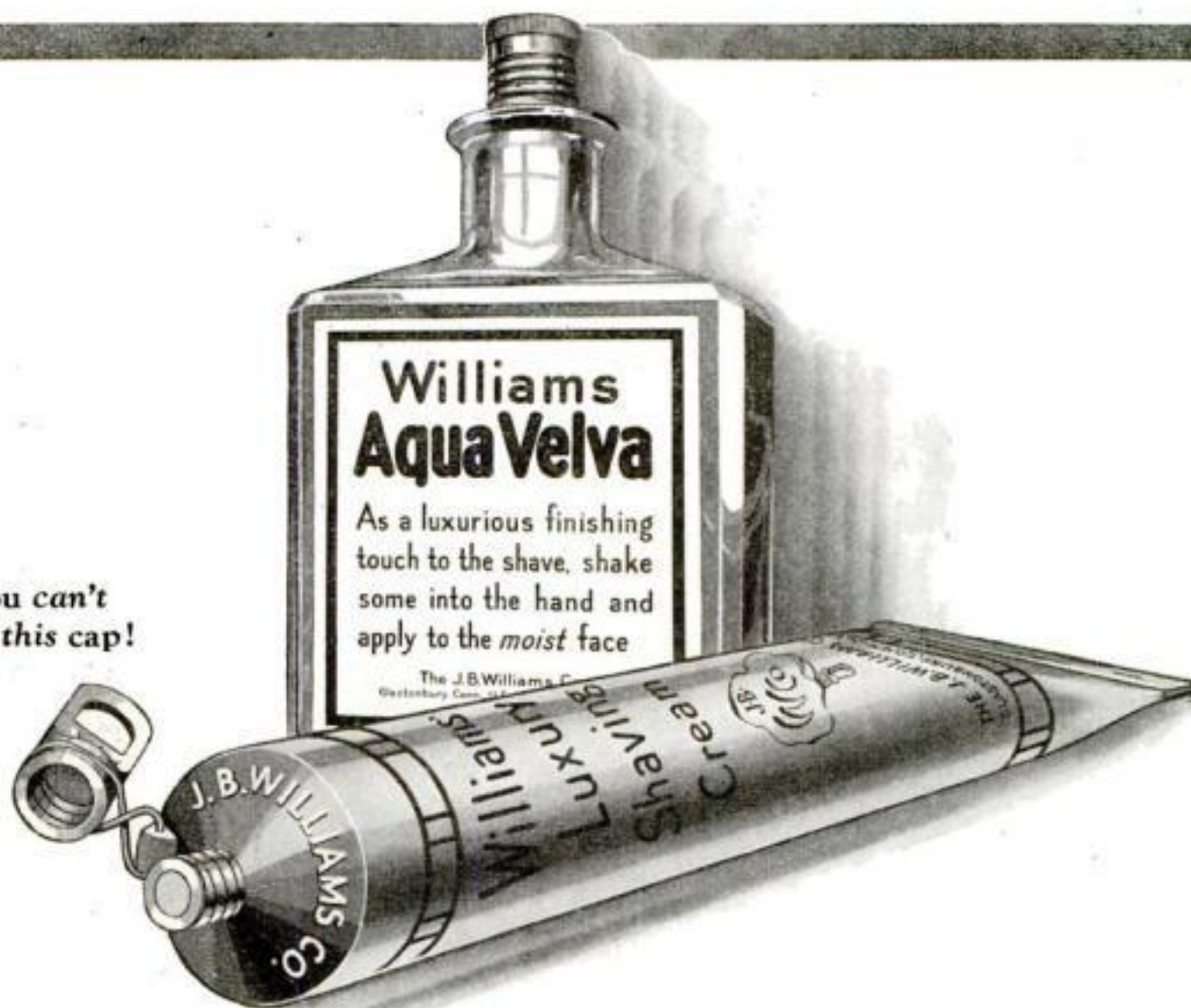
"I guess the worm didn't intend to do it," Alec grinned. "He just made a mistake. Anyhow, we were rolling along at a good clip when the motor coughed a couple of times and then quit cold. It sounded to me

(Continued on page 166)



An ingenious and resourceful mechanic's novel temporary repair of a broken steering arm by winding cord around the arm and the drag link.

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Little Helps for the Motor Enthusiast

Ideas Others Find Valuable

Tank Measures Gasoline by the Mile—Radiator Thawed by Steam—Emergency Grease Gun—A Runway Over a Curbstone

THE simple auxiliary gasoline tank shown in Fig. 1 will prove very useful to the experimentally inclined motorist. With one of these tanks on your car you can determine gasoline consumption in miles per gallon with the greatest ease. You can quickly determine the most economical speed at which to run your car either on the hills or on the level. It will enable you accurately to check the adjustment of the carburetor and it will make it possible to test the efficiency, in the motor of your own car, of the various grades of gasoline now offered to the public.

Fig. 1 shows the location and piping of the tank. If you make the tank exactly $2\frac{23}{32}$ inches inside diameter, one inch on the float scale will equal exactly $1/10$ of a quart. The float should be a loose fit and the scale rod attached to it can be a piece of quarter-inch dowel rod. The

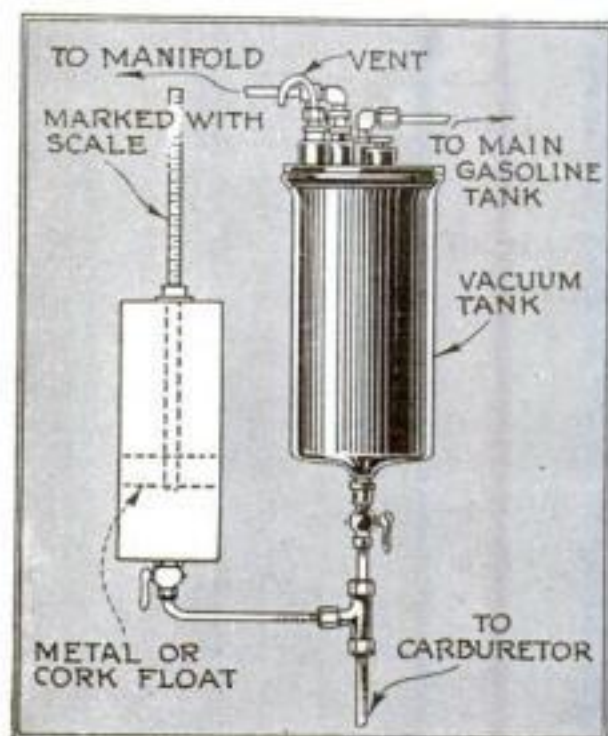


Fig. 1. An auxiliary gasoline tank with a gage that enables you to determine gas consumption and to check carburetor adjustment.

tank should be located just low enough so that the vacuum tank will almost fill it with gasoline.

To test for gas consumption, stop at the beginning of a level stretch, turn petcocks so that gas will flow from the test tank, note the scale reading, drive over the test stretch, and again read the scale. Two inches on scale indicates twenty miles to the gallon. Economical carburetor setting is obtained by running over the test course after each change, and so on. The vacuum tank will automatically refill the test tank when both cocks are left open.



Fig. 2. With a length of hose attached to the lower outlet of your overflow pipe, you can convey steam through the fins of a frozen radiator and speedily thaw it out.

Steam Thaws Radiator

IF YOUR radiator freezes while you are driving, a simple way to thaw it, as shown in Fig. 2, is to attach a short length of rubber hose to the overflow pipe from which the steam is flowing and squirt the steam through the fins of the radiator. Start at the top and work downward. Keep the motor idling slowly

and when the flow of steam stops you will know that all the ice which has clogged the lower portion of the radiator has melted.

Emergency Grease Gun

ONE of the messiest jobs about an automobile is filling the differential housing with grease if you have no grease gun. To avoid this difficulty, make up a cone from several thicknesses of newspaper, fill it with grease, and insert the end of the cone in the filler hole in the rear end housing. Now start rolling the large end of the cone as shown in Fig. 3, and if the cone has been carefully made, you will get all the grease in the hole without soiling your hands. If the grease is very stiff because of cold, it will be well to warm it a trifle before attempting to do the job, so that it will flow into the hole easily.

Ten Dollars for an Idea!

FRED J. SEVERS, of St. Louis, wins this month's \$10 prize with his suggestion for a gasoline gage (Fig. 1). **POPULAR SCIENCE MONTHLY** awards \$10 each month, in addition to regular space rates, to the reader sending in the most valuable suggestion for motorists. Other published contributions are paid for at regular rates.



Fig. 3. To fill the differential housing conveniently put the grease in a cone made of newspaper and squeeze it out like tooth paste.

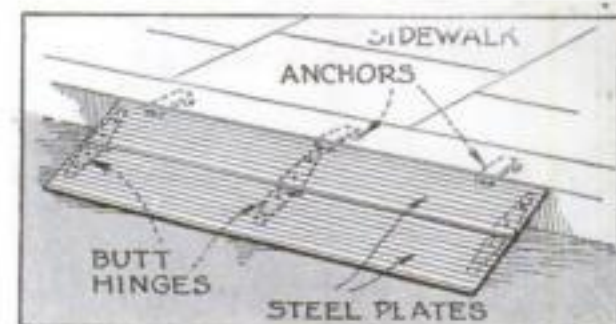


Fig. 4. Steel plates fastened together make a folding runway to take your car over the curb that stands between garage and street.

Fig. 5. Sectional diagram showing runway open and closed and details of its construction.



Novel Folding Runway

IN CASES where it is desired to have a curb on the sidewalk opposite the driveway to your garage, some provision must be made to eliminate the constant pounding your tires will get if they are forced to climb the curb every time you drive the car in. A simple solution of this problem is shown in Figs. 4 and 5. Two steel plates of equal width and as long as the driveway is wide are fastened together with extra heavy butt hinges. Three hinges will do for a light car but for a heavy model use five or six. The upper hinges, or anchors, can be imbedded in the concrete when the curb is formed; if the curb is already made, they can be bolted to it by means of lag screws in expansion shields.

7

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Odd-Job Tips for Handy Men

Razor Blade Disposal— Ironing Board and Drier

WHAT to do with safety razor blades—that eternal question—may be answered in the home by adopting the method used on Pullman cars. Cut a hole through the plaster of the bathroom wall and place a piece of slotted metal over it, as shown in Fig. 1. Old blades deposited through the slots fall between the partition walls, where there is room for an accumulation of a lifetime.

If the opening between the partition happens to extend into the cellar, it can be

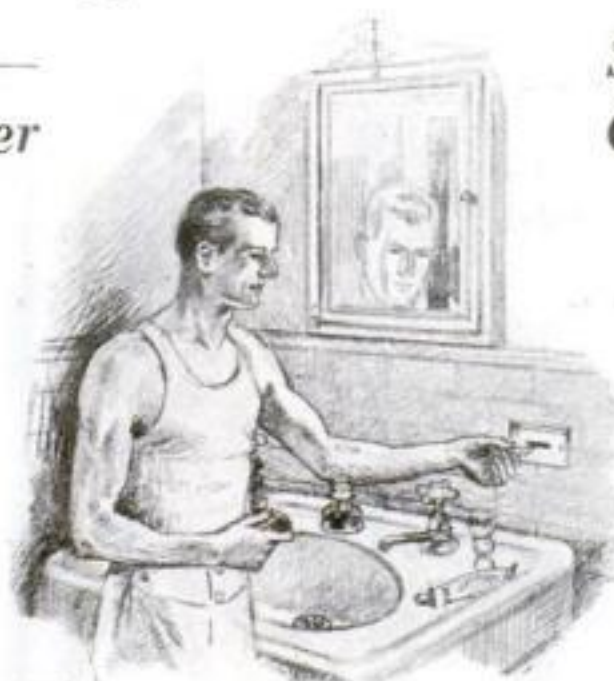


Fig. 1. A slot through the plaster allows the blades to be dropped behind the partition walls.

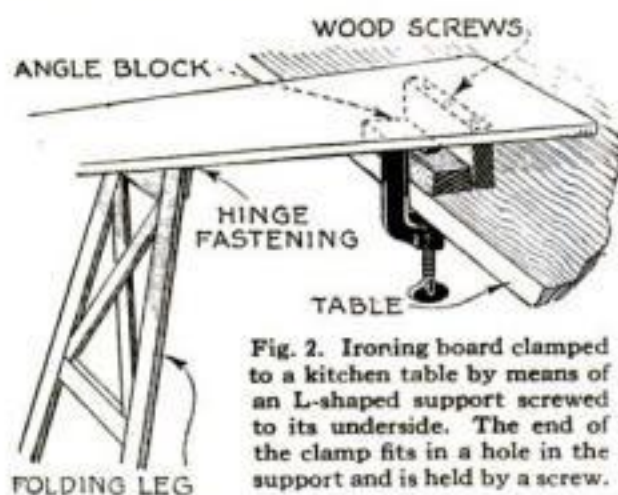


Fig. 2. Ironing board clamped to a kitchen table by means of an L-shaped support screwed to its underside. The end of the clamp fits in a hole in the support and is held by a screw.

sealed at the bottom with a piece of wood or wall board.

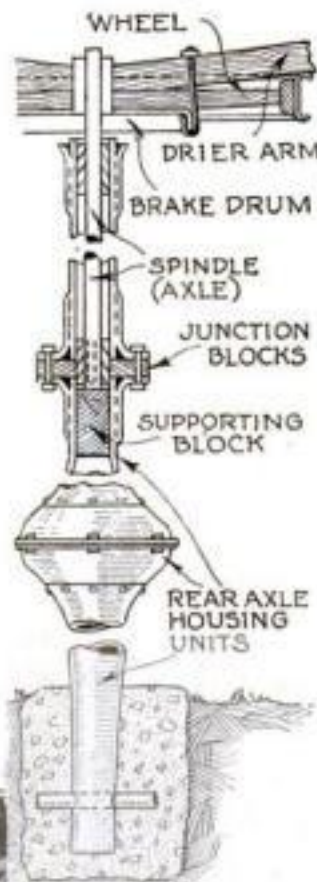
Should the appearance of the slot be considered undesirable, it sometimes can be cut within a medicine cabinet, or placed in an inconspicuous corner or behind a towel rack.—FRANK M. DUGAN.

SIMPLE as it is, the ironing board illustrated in Fig. 2 has much to commend it for use in a kitchen or laundry where no built-in board is available. The large end of the board is raised above the table or other support by means of two pieces of wood fastened together to form an L-shaped support as shown.

Before this L-shaped member is screwed to the board, a shallow hole is bored to receive the end of a C-clamp and a wood

screw is driven in to hold the clamp in place. The other end of the ironing board is supported by a light framework, which is hinged so that it can be folded against the board for compact storage when not in use.—FRED MILLER.

OLD automobile parts can be used to make a practical and substantial revolving clothesline support, as illustrated in Fig. 3.



the joint is assembled, a round block of wood 2 3/4 in. long is driven into the upper opening of the middle housing. This block supports the axle and the roller bearings in the upper housing.

It will be seen that the enlarged end of the uppermost housing has been trimmed off with an oxy-acetylene torch so that the wheel can turn freely. Six arms 2 by 2 in. by 6 ft. are fastened to the wheel with

Smoke-Pipe Coupling— Clothes-Hanger Supports

1/4 by 6-in. bolts, each of which is bent so as to form a short hook at the head end. This end is hooked around the brake drum and run through a hole in the arm. Three lines of wire are run through holes in the arms.

Because of its roller bearings, the clothesline holder turns easily, yet the construction is rigid and substantial. While the automobile parts used in this case are from old Ford cars, others could be used as well.—D. L. DALKE.

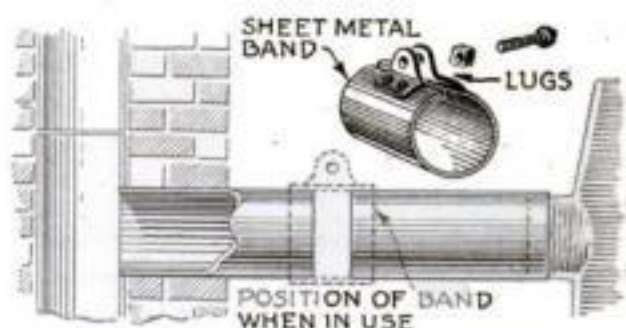
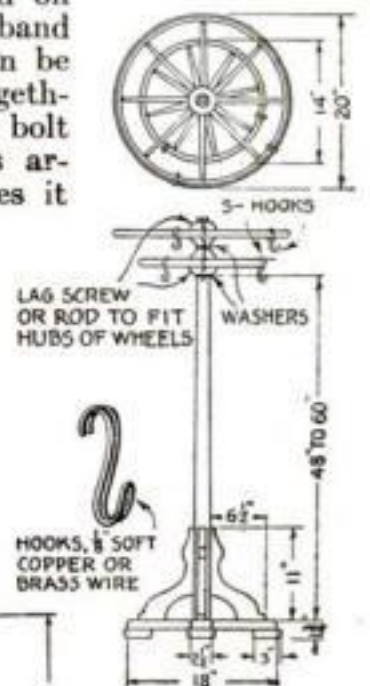


Fig. 4. Clamp for furnace smoke pipe, which allows the pipe to be removed for cleaning.

IT IS a simple task to remove a smoke pipe in order to clean out the soot, if a joint is provided as shown in Fig. 4. A section of smoke pipe is made of No. 18 gage brass and cemented in the chimney opening; this pipe should project at least 4 in. A piece of ordinary galvanized pipe is then cut so that when one end is connected with the heating plant the other end will stand about 1/2 in. or a little more away from the brass pipe. The two pipes are joined by means of a metal band lined with sheet asbestos.

Lugs are riveted on the ends of the band so that they can be drawn tightly together with a stove bolt and nut. This arrangement makes it possible to remove the longer section of pipe for cleaning, whereas, when one length of pipe is used and cemented

(Continued on page 125)



HOOKE, 1/2 SOFT COPPER OR BRASS WIRE

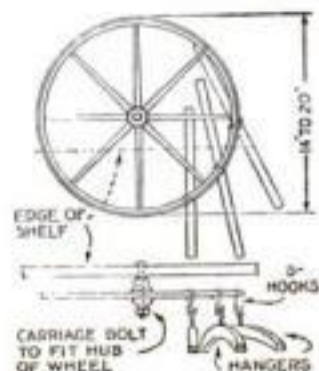
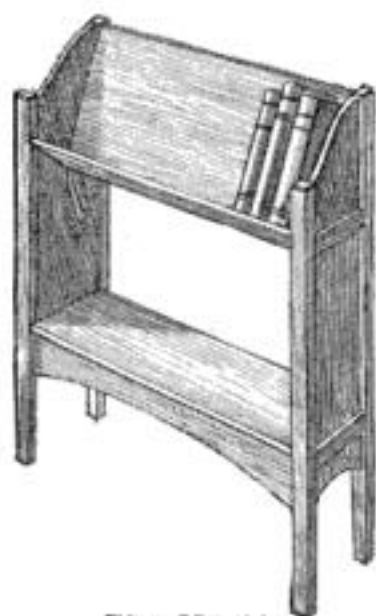


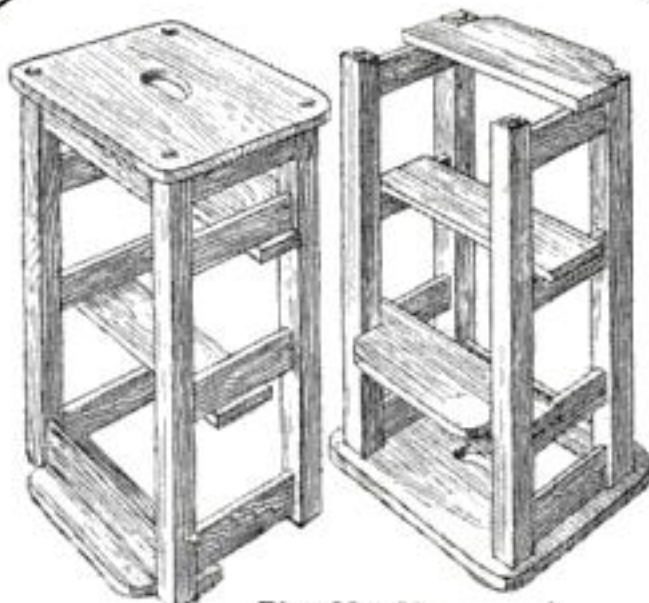
Fig. 5. Ingenious revolving costumer made by mounting two baby carriage wheels on a wooden upright. At the left is a wheel similarly used, but mounted under a wide shelf in a clothes closet.



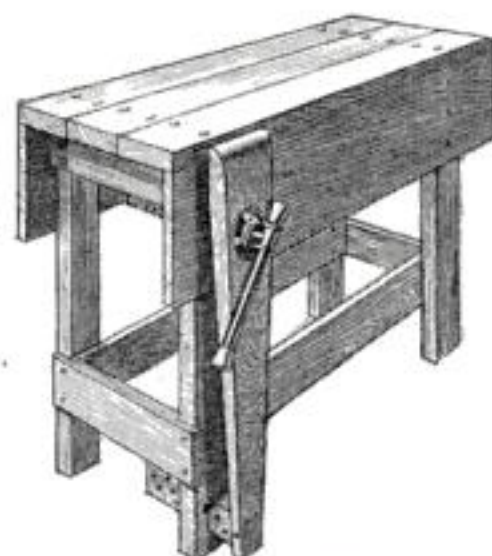
Fig. 3. Revolving clothesline supported by arms bolted to an auto wheel, which is mounted on a standard composed of rear axle units. The diagram reveals the construction.



Plan No. 11c



Plan No. 20c



Plan No. 72c

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- 2e—Candle Stick
- 3e—Pipe Rack
- 4e—Flower Box
- 5e—Table Lamp
- 6e—Toy Automobile
- 7e—Sconce
- 8e—Dinner Gong
- 9e—Bird Houses
- 10e—Dog House
- 11e—Book Stand
- 12e—Smoking Cabinet
- 13e—Kitchen Cabinet
- 14e—Sewing Cabinet
- 15e—Cedar Chest
- 16e—End Table
- 17e—Tea Wagon
- 18e—Model Sailboat
- 19e—Combination Sail- and Row-boat
- 20e—Combination Kitchen Seat and Step Ladder
- 21e—Garden Seat
- 22e—Garden Trellises
- 70e—Small Tool Chest
- 71e—Large Tool Chest
- 72e—Work Bench

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Models That Fly Farther

How to Build More Speed and Distance into Your Miniature Aircraft—Bamboo, Covering Materials, Propellers, Fittings

By J. DANNER BUNCH and AVISON F. KOCH

MANY enthusiastic constructors of model airplanes are hampered by a lack of facilities. They do not find difficulty in obtaining the few tools needed, but they often discover that it is no easy task to buy suitable materials. Every model builder should get the catalog of at least one well-known model supply house and familiarize himself with standard materials and fittings.

Bamboo is perhaps the most important material. It can be obtained from model supply houses in lengths up to 15 in., straight, true, and of the best quality. Bamboo is used for ribs, undercarriage members, struts, and in some of the advanced scale models, such as the *Bremen* (POPULAR SCIENCE MONTHLY Blueprints Nos. 89 and 90), the entire fuselage is made of this very light, strong, and easily bent material.

In using bamboo to make ribs, cut it to the correct lengths and thickness and then bend it to the curve. Split it to the correct width after curving. Incidentally, wide pieces are more easily matched to the curves on the layout or drawing than are narrow ribs. In this way it is possible to make three or four ribs from each wide piece.

For short lengths such as are used in pontoon braces, dress wide pieces to the proper thickness and length and then



Whittling propellers quickly and neatly is one of the most important things the model airplane enthusiast has to learn.

split off the width with a sharp knife.

In forming wing tips for single surface wings, the writers make the tips long for the reason that they are easier to cover, and the natural curve of the bamboo forms the shape without the necessity of using heat. Any small difference in the shape of the tips can be pressed out with the fingers.

For double surface wings it is best to have the overhang of the spar a little long. To the leading and trailing edges bind tips of a length sufficient to give the correct span and then trim the spar overhang to a length to fit the natural curve of the bamboo. In this way the usual difficulties of making gracefully curved tips are overcome.

When special shapes are required, it is advisable to make a full size drawing and bend and match the curves. If the strips are marked at the points where bends are made, it is a simple matter to apply candle heat at the proper points.

NUMEROUS good covering materials are available. For experimental models Japanese tissue is the best. Rice tissue and bamboo paper are heavier. Very light models may be covered with ordinary tissue paper. When sturdy models are wanted for pleasure flying or exhibition purposes, China silk is an excellent covering and the strongest of all.

Extreme care should be used in applying covers. Smooth out all wrinkles by pulling the material lengthwise, but do not pull it until it is under tension—only

enough to smooth out the wrinkles.

The best "dope" is airplane nitrate diluted in varying degrees with acetone. The lighter the frame, the more acetone should be used. Nitrate dope can be obtained in as small as quart-size containers from airplane supply houses. It is not at all expensive.

Banana oil is used by many constructors. This can be purchased at drug and paint stores, but the banana oils more recently placed on the market sometimes have foreign ingredients which make them better for lacquering purposes but unfit them for use as dope. They are not to be depended upon unless the builder knows by actual experience with the banana oil he has on hand that it will do the work satisfactorily. Banana oil should be diluted with acetone for the lighter models.

White pine for the frames can be obtained at local planing mills. If you have it sawed to accurate size, it will need little finishing other than sandpapering. It is well for the model builder to keep a stock on hand. A good selection of standard sizes is as follows, all pieces being 3 ft. long: 36 pieces $\frac{1}{8}$ by $\frac{3}{16}$ in., 24 pieces $\frac{1}{8}$ by $\frac{1}{4}$ in., 12 pieces $\frac{1}{8}$ by $\frac{1}{8}$ in., 12 pieces $\frac{3}{16}$ by $\frac{3}{8}$ in., 12 pieces $\frac{1}{8}$ by $\frac{3}{16}$ in. The pine should show a slight grain.

For propellers (Continued on page 137)

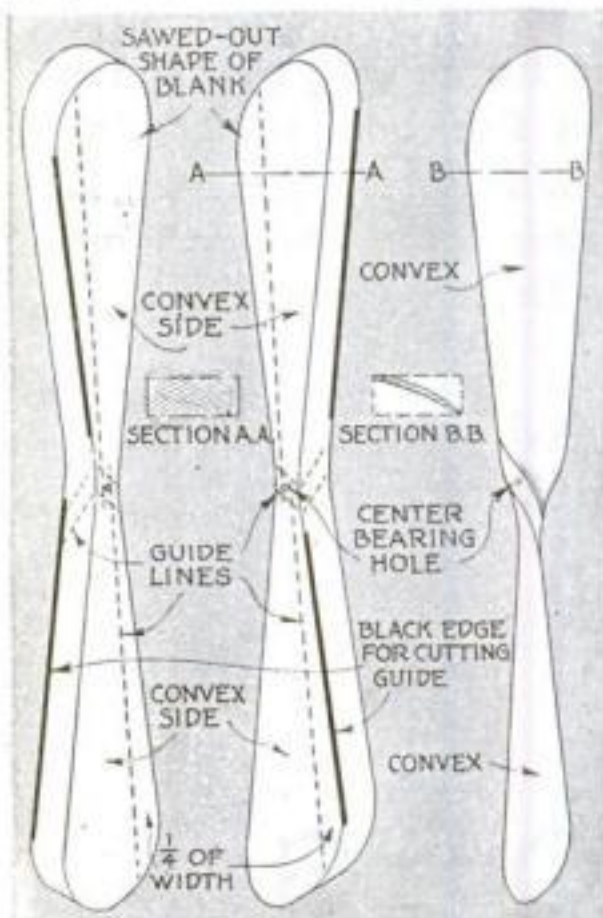


Fig. 1. Two views of the front of a blank marked for carving; the finished propeller.



Blueprints That Make Model Building Easy

IF YOU are a model airplane builder or wish to become one, you cannot do better than make use of our blueprints. They have been tried and tested by thousands of readers.

In the order of difficulty, beginning with the easiest one, the blueprints are: No. 82, a single-stick, hand-launched model; No. 86, a twin racer; No. 50, a rise-off-ground tractor; No. 87, a sea-plane; No. 69, a 3-ft. flying model of the *Spirit of St. Louis*; and Nos. 89 and 90, a 3-ft. flying model of the low-wing Junkers plane, the *Bremen*. There is a coupon on page 102 for ordering blueprints.

C & L 158

This blow-torch is especially made and priced for the man who likes to do odd jobs around the house, or to tinker with mechanical things. It will last a lifetime if it is not abused. The usual retail price is about five dollars. Most hardware, electrical and automobile accessory stores have it—or can get it for you quickly. Look for the red handle.

Time tells the better value of Clayton & Lambert torches

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The ability of Clayton & Lambert blow-torches to prove their "class" in the test of time and use has made them the largest selling blow-torches in the world. This is not the result of mere honest manufacture. It is caused by our ceaseless seeking for improved performance, improved design, improved materials—shown by a string of blow-torch patents as long as your arm.

Why is the brass tank given a satin finish, instead of shiny? Because buffing the metal weakens it in some spots—and these would "give," in time. Why a lead washer in the filler plug, instead of leather? Because it wears longer. Why a double spring on the pump valve? Just one reason—satisfaction year after year.



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Handles so attached that bending or breaking them can't make the tank leak, protection for the base of the tanks, to guard against rough handling. Only one reason—longer service for you.

The patented burner orifice on No. 32 can't be spread, no matter how careless a man is in shutting the valve too tight—again, longer service for you.

About the only thing on Clayton & Lambert blow-torches not placed there for the special purpose of giving you better performance over a longer period, is the red paint on the handles. And that's put there so you can identify these torches, and get their greater value, the minute you see them.



C & L 32

This is one of the most popular blow-torches we have ever made. It is more expensive than the 158 because it is made for much harder use. It is designed for the man who uses a blow-torch in his daily business and demands not only excellent performance but rugged ability to stand rough handling. 32 contains the most advanced, patented C & L blow-torch improvements. It also has a red handle. Sure sign of satisfaction.

Winding Springs Is Easy

Once You Know How to Tame Music Wire and Other Stubborn Stock and Can Make Mandrels and Tools

By H. L. WHEELER



Springs are frequently needed in the jobbing shop. Machine-shop hand-books give mandrel and wire sizes and data for winding.

IT WAS a proud moment for Jack Hinds when he stepped out as a journeyman machinist. Decked out in his brand-new overalls and quite confident of his own mechanical knowledge, acquired in four hard years of apprenticeship at the railroad shops in his home town, he presented himself to Ed Wilkins, foreman of the general jobbing shop in which he was to work.

With alert precision, he answered the questions which the mild-spoken foreman asked. He could see that Wilkins was the sort of man to take a kindly interest in young fellows. This discovery surprised him a little, because he had heard indirectly that Wilkins was considered to be hard-boiled and a record breaker in respect to the amount of work he turned out with his shop force of twenty men.

After Jack had been registered by the time keeper and the tool-crib man, Wilkins handed him a blueprint of a coil spring such as is shown in Fig. 1, to be made of No. 30 music wire.

"You will find a box of short ends over by the hack saw," the foreman said. "Pick out a piece of half-inch round stock about ten inches long and make an arbor. Center both ends and drill a hole for starting the wire. You may use that twelve-inch lathe over in the corner."

JACK drew the wire from the stock room while trying to recall how the old-timers in the railroad shop had wound springs. The truth is, he had never done it himself and, indeed, had never handled music wire. He thought it would be easy

enough and intended to do his best without asking questions.

What Jack did not realize is that while music wire is one of the most commonly used materials for making coil springs, it can give a mechanic all sorts of trouble if he does not know how to handle it.

He tore off the moisture-proof paper from the coil of wire and proceeded to cut the four pieces of wire with which it was bound. Grasping the coil in his left hand, he snipped the wires one after the other. Some of the boys in the shop were watching him, and they held their breath as he was about to cut the last binder.

Snap! The coil flew from his grasp and

bounced across the floor. Jack, shocked by the suddenness of this accident, rubbed his badly rapped knuckles.

Wilkins had seen what had happened from across the shop and came up just as Jack was picking up the hopeless tangle of wire.

"We won't waste any time trying to untangle this mess," the foreman commented calmly. "I am quite willing to show you how to handle this spring job, but we'll have to charge the spoiled wire against your time. Get another package from the stock room."

"WATCH this," said Wilkins, as he unwrapped the new package. First he cut two of the binders; then he placed the coil on the floor and stepped on it with both feet in such a way that the two remaining binders were in front. Bending over and easing up the foot pressure, he cut the binders. The coil expanded beneath his feet and came to rest at about twice its original diameter.

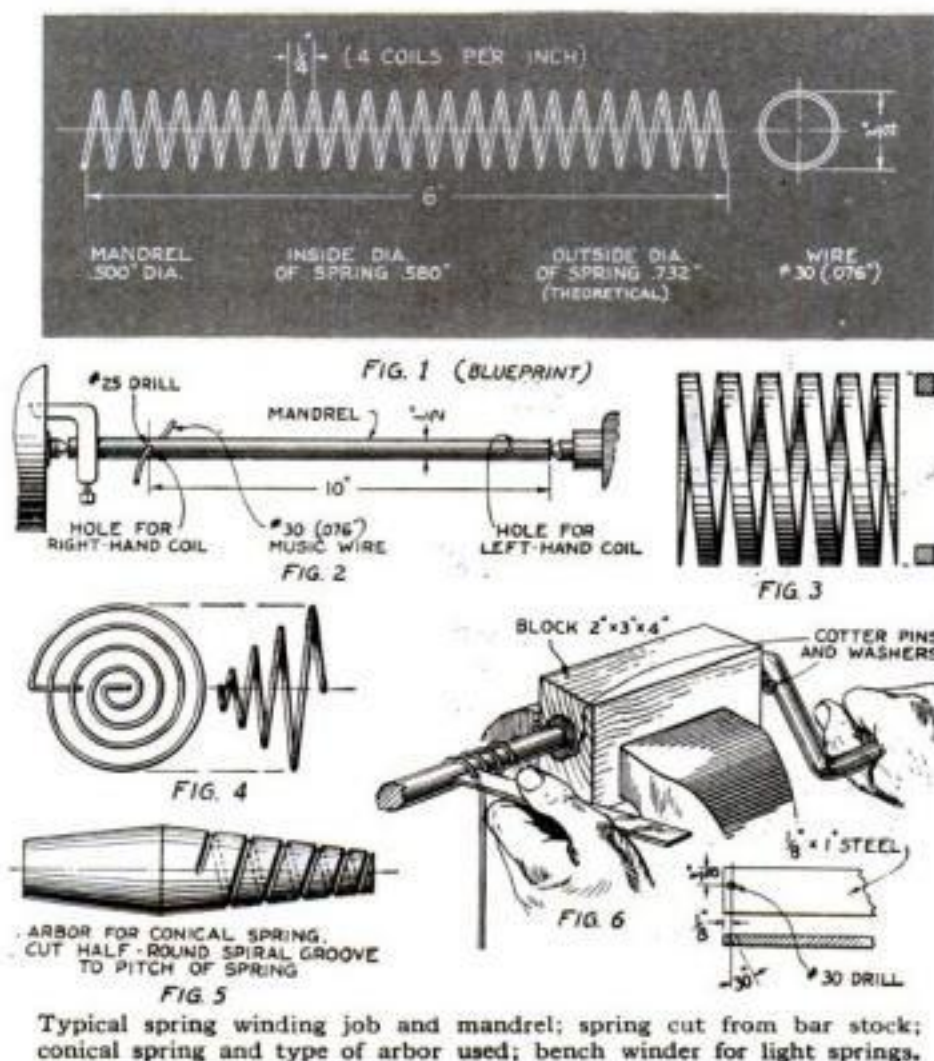
"Now it can be picked up without becoming snarled or entangled," he explained.

Wilkins tied the bundle in two places and pulled the end through far enough to allow several springs to be made.

Even experienced mechanics, it should be mentioned, often use a poor method in handling a new coil of music wire. Without releasing the tension, they pull out enough wire to make two or three springs. As the coil becomes reduced in size by this method, the binders loosen and slip around. Then the wire springs out something like a fan, and the coils are easily kinked and tangled. I have seen half-used bundles of music wire so badly tangled because they had been opened in this way that it was cheaper to scrap them than to try to salvage them.

Wilkins looked over the lathe that Jack was to use

(Continued on page 123)



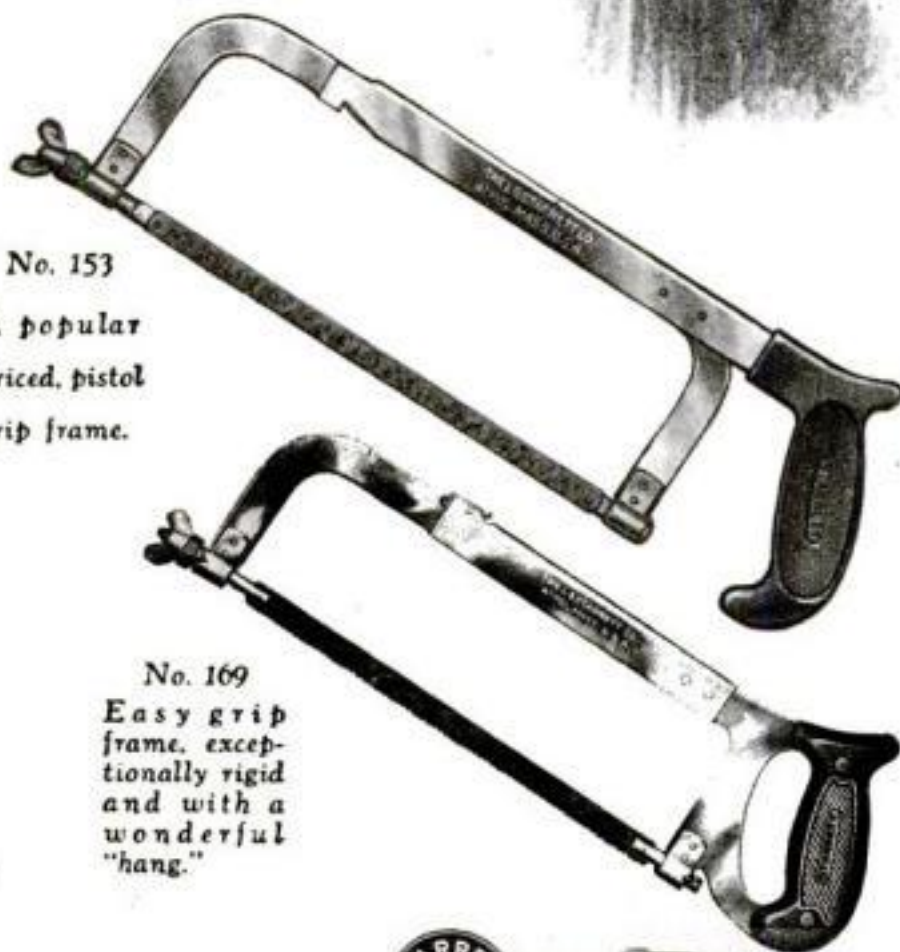
Typical spring winding job and mandrel; spring cut from bar stock; conical spring and type of arbor used; bench winder for light springs.

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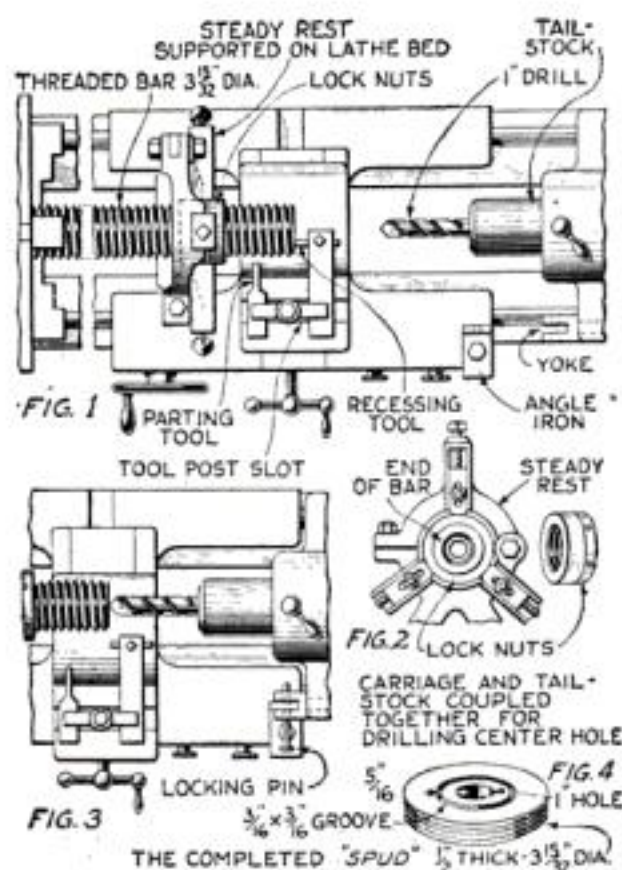
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Use Starrett Hacksaws

How Shop Men Cut Corners

Adapting a Lathe for Production Work—Two Ingenious Milling Kinks



An unusual lathe set-up for manufacturing a number of parts like that shown in Fig. 4.

WE HAD an order recently for a quantity of "spuds" as shown in Fig. 4 above. The shop's equipment included nothing more suitable for the work than an engine lathe, but we developed tooling equipment that made the job very simple. And the same principle can be applied to other lathe work of similar character.

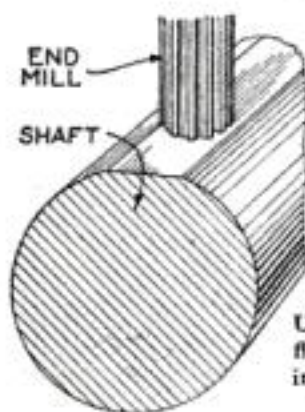
For the first operation we centered one end of a long bar of steel of the required size, and, holding the other end in the chuck, threaded the entire length to fit the gage. The bar was stiff enough to be threaded for its whole length without a steady rest. Had the work been smaller, it would have been handled in shorter lengths.

We had a pair of nuts (Fig. 2) made so

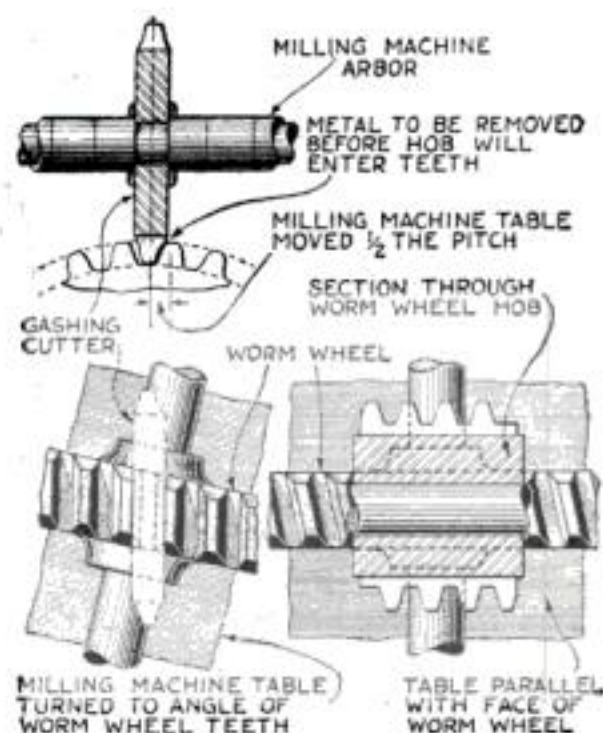
that we could run the bar in a steady rest without damaging the threads. One of these nuts was smooth for the steady rest jaws to run upon; the other had holes for a spanner. The nuts were locked in place some distance from the end.

Then came the work of drilling the hole in the end and trepanning the recess. The set-up shown in Fig. 1 was used for this purpose. A 1-in. drill was held in the tailstock, while a special tool for forming the recess and a cutting-off tool were mounted on the compound rest.

In order to drill the hole with power feed, we made a connection for the tailstock (Figs. 1 and 3) that enabled us to couple it to the carriage at will, throw in the power feed, and drill. This was much easier than using the hand feed. The connecting device consisted of a yoke screwed into a hole in the tailstock and an angle bolted to the carriage. These were mounted so that a loose pin could be put through them (Fig. 3) for coupling the carriage to the tailstock. This sort of ar-



Using a milled flat for centering an end mill.



Diagrams showing how a cutter that is too narrow can be used to gash a gear wheel.

range is useful in any shop for drilling in the lathe, but one caution must be observed: the clamp bolts on the tailstock must be loosened so that they will not bind, or the feed gears in the apron will be damaged.

With the tools mounted on the carriage, there was little difficulty in completing the parts. The machinist made a mark on the cross slide so that he could locate his recessing tool without measuring. He got the depth with a small depth gage. Possibly some sort of indicator could have been devised to avoid doing even that measuring.

The cutting off was done with a parting tool bolted to the compound rest. It will be noted that a special clamp and bolt were used to hold the two tools rather than the usual tool post. This made a very rigid arrangement.

This set-up made it possible to do on an engine lathe a job that without it would have been very tiresome. All the tools were available without changing.
—ALBERT E. BIRD.

Old Bill Says—

WHY hesitate to use your magnifying glass to sharpen a small drill when obviously you can get more accurate results by doing so?

If you sharpen the chamfer of a reamer free-hand and then find you can produce a standard size hole, make up your mind it is luck and not brains.

As the same drive arbor or mandrel cannot serve for every job of a certain bore, it is necessary to have the arbors in sets of three, tapering .0002, .0005 and .0007 in. to the inch respectively.

Aluminum can be reamed accurately with one-blade reamers of the boring tool type.

Throwing a ball of waste or rags at your friend across the room is dangerous sport. This game often ends with lead hammers.

In wet grinding machines, even if the tank is cleaned every week, an odor is often noticeable, especially in warm weather. A teaspoonful of cheap disinfectant added to every gallon of the grinding solution will improve this condition.

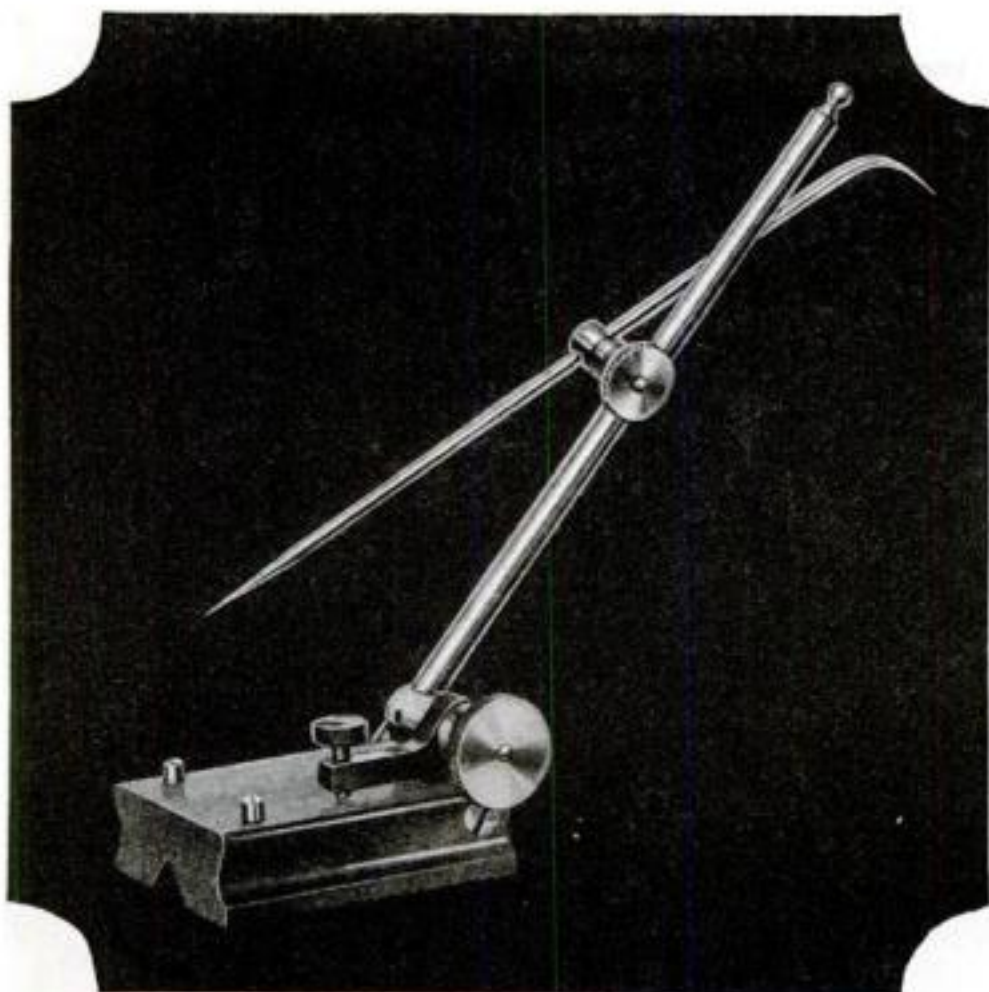
Do not stand directly in front of a large grinding wheel when snagging or roughing out work. Even if the guard is on, the odds would be against you in case of a break.



A TWO-PITCH 25-tooth worm wheel had to be made and, although we had the proper hob for the job, the only available gashing cutter was too narrow. After we had gashed the wheel we found that the hob would not start because the teeth on the wheel were still too wide at the points.

The machinist working on the gears wanted to go at the job by the cut and try method, but I stopped him and figured out the following process, which is a generating method, for a worm and worm wheel are only a modified form of a rack and pinion.

After having gashed the wheel all around, set the vertical feed screw dial on "O" with the gashing cutter at the bottom of the cut. Now drop the table till the cutter
(Continued on page 125)



Brown & Sharpe Surface Gauge No. 621, illustrated above, permits a wide range of adjustments. A fine tool that any mechanic will be proud to own.

Fine Tools Increase A Man's Mechanical Ability

Because their unfailing accuracy increases the certainty of measurements, Brown & Sharpe Tools lower the percentage of loss and waste in mechanical work. The mechanic who makes use of these finely designed tools finds them an aid in bringing out his skill to best advantage and in increasing his value as a producer.

There are over 5,000 items listed in Catalog No. 30. Get a free copy from your dealer or from us direct. Dept. P. S., Brown & Sharpe Mfg. Co., Providence, R. I., U.S.A.

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* PLANER AND SHAPER GAUGE
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* STAINLESS
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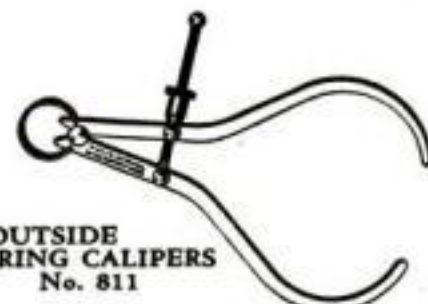
* THICKNESS
GAUGE
No. 648



* DIE MAKER'S
SQUARE
No. 552



* COMBINATION SET
No. 438



* OUTSIDE
SPRING CALIPERS
No. 811

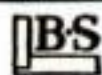


* SCREW PITCH GAUGE
No. 630



* ADJUSTABLE SQUARE
No. 554

* A description of this tool appears in Catalog No. 30



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The NEW 1929 KUPROX A.C. POWER PACK

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2. **Voltage Regulator.**—Tapped transformer and rotary switch permits adjustment of output voltage to meet individual set conditions.
3. **Plug Receptacle.**—Eliminates need of connecting "B" Unit to separate lamp socket and controls current supply automatically.
4. **Non-Turning Binding Posts.**—This patented construction successfully overcomes one of the many inconveniences of the common, less expensive types usually employed.
5. **Control Switch.**—Positive operated pendant cord type controlling both "A" and "BC" Units (where the latter are used) eliminates the use of switch on receiver.
6. **A. C. Cord and Plug.**—Of ample length for all ordinary purposes. This may be added to or reduced in length where necessary.
7. **Oversized Transformer.**—This is constructed of the finest silicon steel and heavy copper wire eliminating heat and developing the highest possible operating efficiency.
8. **Filtering Condensers.**—Patented, dry paper type, each containing 2,500 to 10,000 Mfd. capacity, insuring perfect filtering. Three employed. Absolutely dry, will not puncture and are long lived.
9. **Kuprox Rectifiers.**—These employ the new large 2" KUPROX discs, insuring ample carrying capacity, steady output and long life.

When Popular Science Monthly, after rigorous testing, placed its unqualified approval on the new 1929 Kuprox A. C. Power Pack, it substantiated the verdict of every radio engineer who has examined and tested this efficient new unit. Radically different from any previous model, vastly improved from every standpoint, the new 1929 Kuprox A. C. Power Pack represents a real achievement in engineering and construction. New throughout, even in size, it is a rugged, long-lived instrument that completely modernizes the receiver to which it is attached. The new construction insures permanently carefree operation and service. Several models from \$32.50 up.

in rigorous tests conducted by the Popular Science Institute Laboratory

Makes an Electric A.C. Radio of your present Battery Set



**NO CHANGES IN WIRING
NO HARNESS OR ADAPTERS
NOT EVEN NEW TUBES**

You don't have to discard your present radio to get A. C. operation. Now you can electrify your set and make it A. C. with units that have been rigorously tested and proved in the laboratories of Popular Science Institute of Standards.

The new 1929 Kuprox A. C. Power Pack makes an efficient A. C. set of any battery radio. No changes in wiring are necessary, no harnesses or adapters, no tricky installations. Not even new tubes are necessary. **Your set remains exactly as it is, you use the very same tubes as now, you merely connect the Kuprox A. C. Power Pack to the battery terminals of the receiver, plug it into the nearest lamp socket, and that's all!**

Then compare your set with the best A. C. radio you ever heard. Compare the tone, the power, the distance getting ability, the selectivity and ease of control. Not the slightest hum, no distortion or crackling because of faulty tubes, none of the failings that variations in electric current can cause in A. C. sets. **A good battery set, Kuprox equipped, is A. C. reception at its finest.**

And there's nothing at all to bother about. The entire set is controlled by a single pendant switch on the Power Pack. Snap the switch and it's on—snap it again and it's off. The Kuprox A. C. Power Pack is a permanent addition to your set that will double your radio enjoyment.

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Several models are offered, some supplying filament (A) current only, for those who already have a good "B" eliminator; several models that supply plate (B) current only; and two compact units that supply all current (A, B and C) and make the entire set A. C. The Kuprox A. C. Power Pack can be used on any type of receiver using any kind of tubes. The various models are priced from \$32.50 up, and any good radio dealer can show them to you.



Kuprox Replacement Unit, eliminates acids, liquids, bulbs and vibrators from all standard trickle chargers. Easy to install. Makes any standard charger absolutely trouble-proof. Eliminates watering and other bothers. Price \$5.00.

In case you first desire more information, or specific information about your own set, write us, giving the make of set and the number and type of tubes. We'll recommend the proper model you need, and send you literature giving a full description.

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Long, thin, light,
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—assure easy, quick,
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WITH Set No. 1063, tappet adjustment is a simple matter. The six wrenches (2 each of 3 sizes) cover every tappet size from $1/2$ to $7/8$ "—serving 80% of all passenger cars and trucks.

Chrome-Molybdenum construction combines unusual lightness with rugged strength. The thin, narrow jaws of the "SUPERRENCH" will not spread in tappet service. Every "SUPERRENCH" is guaranteed against breakage.

With the proper wrenches, adjusting tappets is easy. Let "SUPERRENCHES" convince you.

Get a SET today.

PRICE:

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SUPERIOR DROP-FORGED TOOLS
"SUPERRENCH"
(Chrome-Molybdenum)
TAPPET WRENCHES

In Simplicity Lies the Charm of This Easy-to-Build Bookcase

By KENNETH R. LAVOY

EVEN in this day of public and circulating libraries, all of us have a few choice volumes and need a convenient place to keep them. The bookcase illustrated at the right is large enough to hold many books and has, in addition, a rack for current magazines. A great advantage of this type of bookcase—one that will appeal to the housewife—is that it does not take up much wall space.

Any man who is handy with tools or any boy who has had manual training in school can make one of these bookcases at home in a few evenings of enjoyable work. The project offers a chance for the use of brushing lacquer, and a professional touch can be given by applying a decalcomania transfer of a pirate ship or other ornamental design on the top piece.

The case should be made of whitewood or other close grained soft wood if it is to have a lacquered or enameled finish, but it can be constructed of mahogany or other cabinet wood, if preferred, and stained and either varnished or lacquered to match other furniture in the room where it is to be placed.

The tools required are a hammer, nail set, plane, turning or keyhole saw, cross-cut and rip saws, square, $3/8$ -in. chisel, and half-round cabinet file.

Shaping the side is the first step. With crosscut and rip saw block out the pieces as shown on page 128; then use a turning saw or a keyhole saw to cut out the shapes exactly. Finish the edges with file and sandpaper.

Cutting the rabbets and dadoes is the



Bookcase with magazine rack at bottom, designed to take up little wall or floor space.

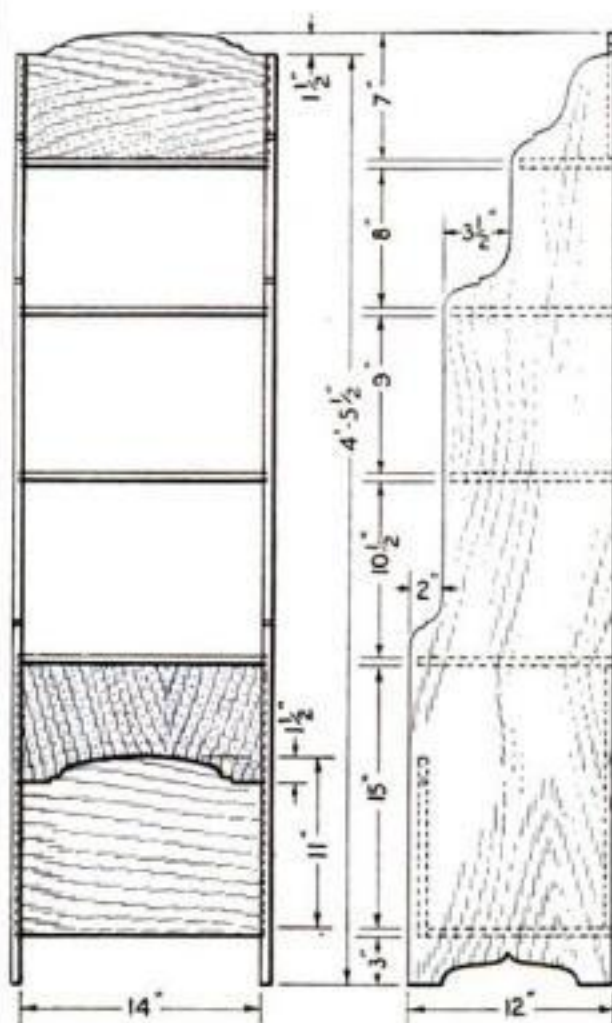
hardest part, but it can be done, in the absence of special planes, with a little patient work with saw and chisel. When cutting the dadoes, clamp a piece of stock along the outside lines to serve as a guide for the saw. Saw down the required depth and then clean out between the cuts with the chisel. If you have a router plane, it can be used for smoothing out the bottom of the dadoes and rabbets.

Getting out the other pieces is a simple operation. About the only question that can arise is the height of the front of the magazine rack. If small magazines for the most part are to be kept in the rack, the front should be reduced in height to 10 in.

When all the parts are ready, sandpaper them thoroughly. Much of the effectiveness of amateur woodworking depends upon the care taken in preparing the surfaces to receive the finish.

The case can be put together, of course, with plain butt joints throughout in order to avoid the

(Continued on page 128)



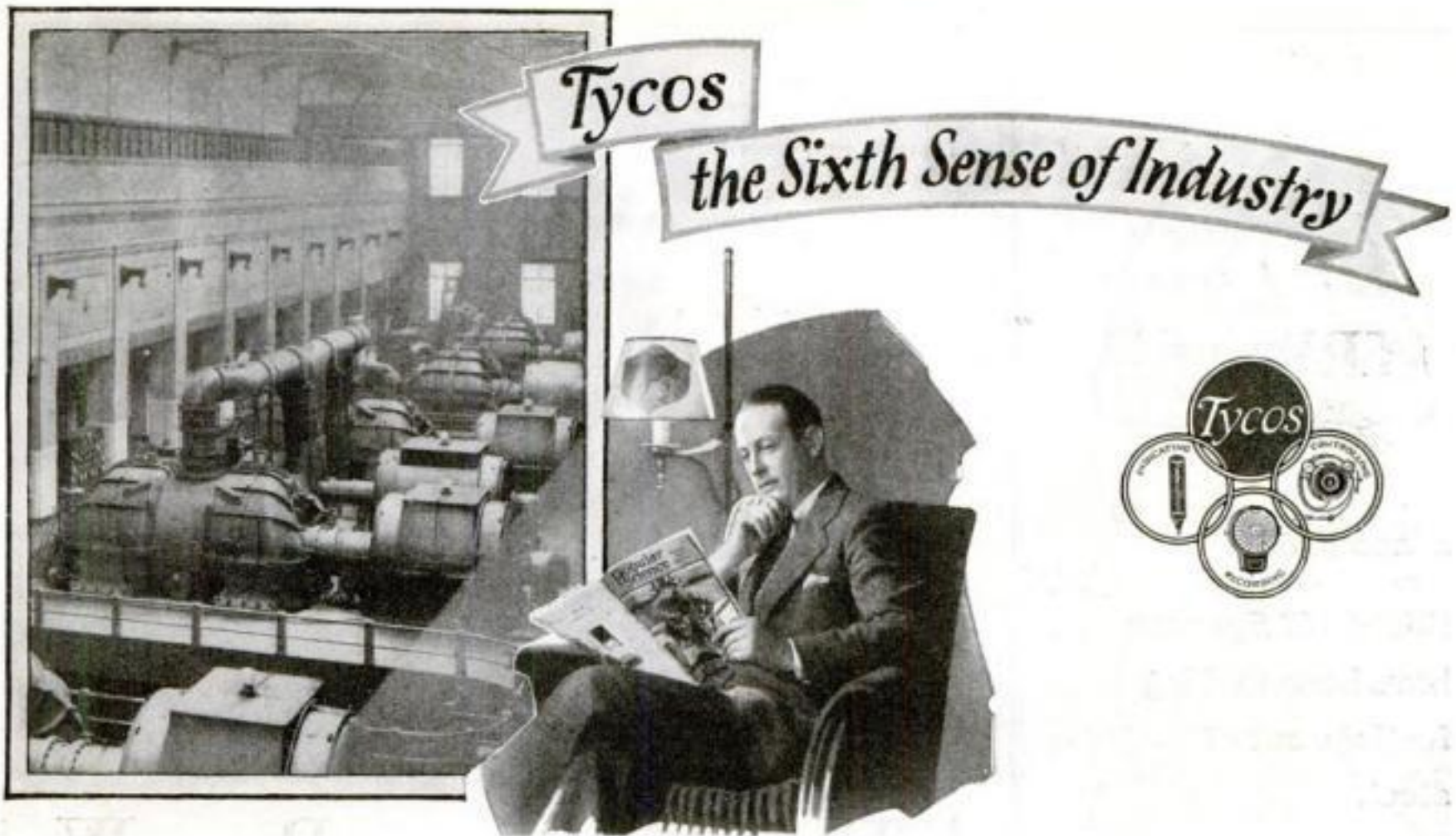
Front and side view of the bookcase. The layout for the sides is shown on page 128

Materials for Bookcase

No.	Pcs.	T.	W.	L.	Part
2	1	$5/8$	12	4 ft. $5 1/4$ in.	Sides
1	1	$1 1/2$	7	$14 1/2$	Upper back
1	1	$1 1/2$	15	$14 1/2$	Lower back
1	1	$1 1/2$	$11 1/2$	$14 1/2$	Front
1	1	$1 1/2$	11	$14 1/2$	Bottom
1	1	$1 1/2$	$11 1/2$	$14 1/2$	Shelf
2	2	$1 1/2$	$9 1/2$	$14 1/2$	Shelves
1	1	$1 1/2$	6	$14 1/2$	Shelf

No. 1 and No. 00 sandpaper, liquid glue, and sixpenny finishing nails.

All dimensions are in inches except as noted.



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IT isn't by chance that the quality of electric lighting for home and industry has been steadily improved—and the cost for electric service steadily reduced. By introducing at every point in the making of electricity the most efficient equipment and methods the engineers of the electrical industry have been able to give you better, and cheaper, light.

Tycos Instruments—the Sixth Sense of Industry—are used in all departments of the electrical industry for insuring satisfactory performance and reducing costs.

The efficiency engineer of one of the biggest public utility companies in the United States says: "We have installed a 60,000 K.W. 3-element cross-compound turbo-generator, one of the largest units in the world. The outstanding variable affecting the efficient operation of this unit is the vacuum. The *Tycos* Instrument has been chosen for the important job of indicating the vacuum on this tremendous unit, which uses so much steam that a reduction of 1% in its efficiency means a loss of about 6,000 lbs. of steam per hour. Our confidence in *Tycos* Instruments is indicated by our installing 152 of them in one of our power stations."

You may not be in the business of making electricity—but if you are in any business in which your manufacturing processes require the Indicating, Recording or Controlling of heat, there are instruments in the *Tycos* Line of 8,000 varieties that will increase the efficiency of your plant operations. Informative literature will be sent you on request. Or one of our engineers will be glad to study your particular problems and make recommendations.

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Canadian Plant: *Tycos* BUILDING, TORONTO
SHORT & MASON, Ltd., Manufacturing Distributors in Great Britain

Tycos for the Home

Tycos Office Thermometers

An aid in promoting human efficiency.

Tycos Bath Thermometers

To enable you to get the most good from your bath.

Tycos Home Set

Bake Oven Thermometer, Candy Thermometer, Sugar Meter. The secret of accurate results in cooking.

Tycos Wall Thermometers

To help you to maintain a temperature in your house conducive to good health.

Tycos Quality Compasses

To show you the right way in unfamiliar country.

Tycos Fever Thermometers

A necessity in every home.

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Forecasts the weather twenty-four hours ahead with dependable accuracy.

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To enable you to keep the humidity of the atmosphere in your home correct at all times.

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Tycos Sphygmomanometer, Pocket and Office types.

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Your dealer will show them to you.
Ask us, on a postal, for booklets
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Bulletins on Request

THE ~ SIXTH ~ SENSE ~ OF ~ INDUSTRY
Tycos Temperature Instruments
INDICATING • RECORDING • CONTROLLING



Since 1865

Billings & Spencer
have been making
forgings out of
steel.

And among these
forgings are
wrenches of all
kinds. "Lifetime
Wrenches"—so
guaranteed.

Good mechanics of
three generations
who have used
these wrenches
say —

That you find the
trade-mark of
Billings & Spencer
on only the
best wrenches
made.

All Dealers can supply you

The
BILLINGS & SPENCER
Company
Hartford, Conn., U.S.A.

The forges are always
open to visitors

Applying a coat of glaze-putty to a bureau-chest built of lumber scraps. The piece, with drawers at each end, is of unusual early American design.



With Glazing Putty You Can Obtain

A Fine Finish on Poor Wood

F. N. Vanderwalker Explains How Rough Surfaces Can Be Painted Smoothly

AFTER sandpapering some wooden surfaces as much as possible, you often will still find, especially on the poorer grades of lumber, certain rough areas that are too deep to be made smooth. These are usually the areas around knots where the end wood fibers are short and run in various directions. Even a plane will not smooth their roughness. In such cases we can follow the example of the old-time carriage painter and apply thin putty with a broad glazing knife—a knife which is about three times as wide as a putty knife and has a somewhat more flexible blade.

Sandpaper should be first used to make the surface as smooth as possible—No. 1 sandpaper, followed by either No. ½ or No. 0. Next a white lead paste is mixed with boiled linseed oil and turpentine in equal parts and tinted as desired with colors ground in oil. This paint is applied and allowed to dry overnight or longer. Then you are ready to glaze-putty.

The putty is made from white lead-in-oil paste, to which enough dry whiting is added to make a stiff, plastic mass. Beat the putty with a wooden mallet or club until it is soft and well mixed. Take a little japan drier and boiled linseed oil in equal parts and add them to the putty together with enough additional whiting to keep the mixture about as thick as butter.

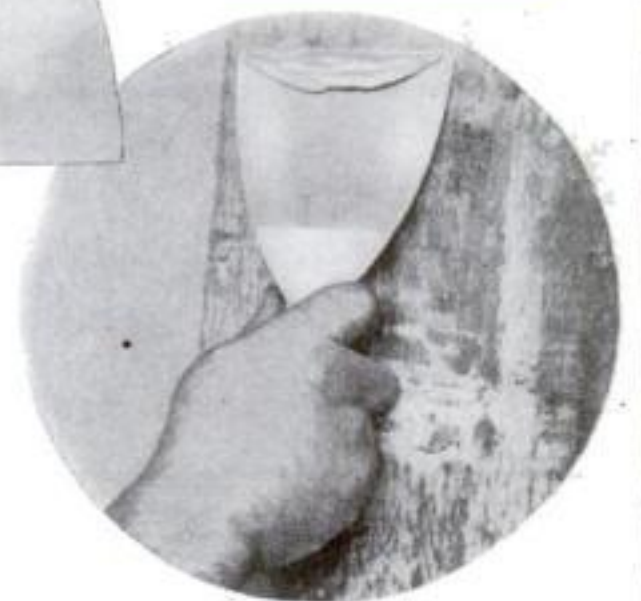
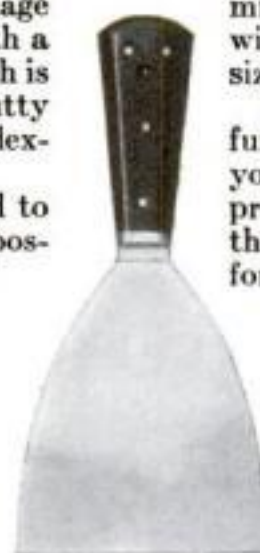
Apply the putty over the surface with the glazing knife and rub it well into all holes, dents, and gouge marks. Scrape off the excess putty and allow the surface to dry hard. Usually in a day or two it

will be hard enough to be sandpapered to a level, smooth surface. If you were careful not to leave tool marks in the putty when scraping away the surface, not much sandpapering will be necessary.

Another glazing putty that will dry very hard and can be rubbed down smoothly with pumice stone and water on a felt pad is mixed from white lead-in-oil paste, dry whiting, and fine, dry pumice stone, grade FF, thinned a little with floor varnish and japan gold size or drier.

By using either of these glazes on furniture, cabinets, or interior trim, you can make cheap lumber take practically as fine a painted finish as the very best wood. The glaze coat forms a fine ground for paint, enamel, or lacquer, especially as the putty

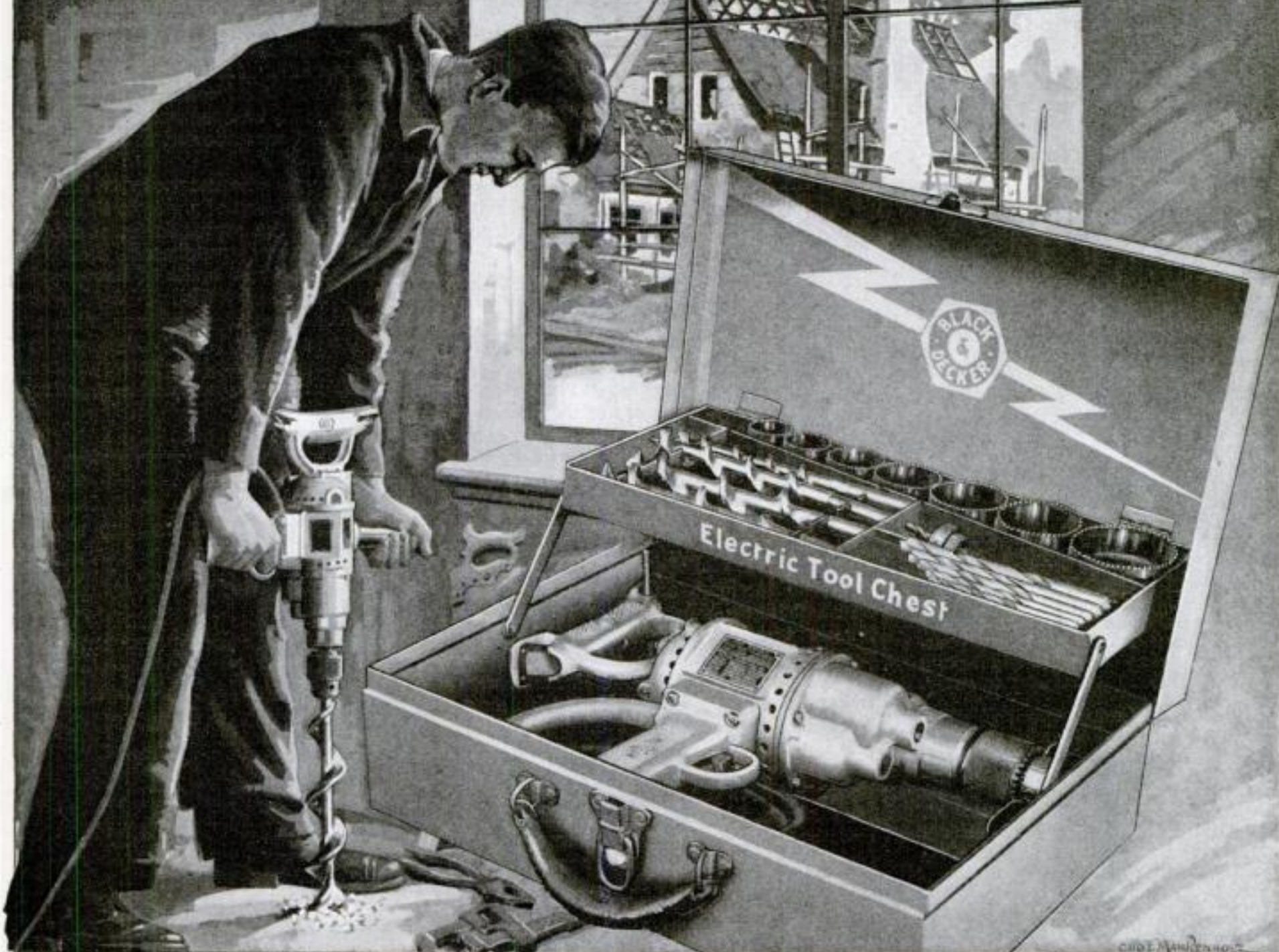
(Continued on page 130)



The glaze, about as thick as butter, is applied to the wood with a broad, flexible glazing knife.

BLACK & DECKER

ELECTRIC TOOL CHESTS



ELECTRICIANS, Plumbers, Carpenters;—Contractors in any branch of industry where holes must be drilled have found it necessary to supplant their old style hand tools with modern electric tools.

Heretofore the famous Black & Decker Portable Electric Drills, "With the Pistol Grip and Trigger Switch", have been sold individually. For your

We will be glad to send you literature describing these Electric Tool Chests in detail if you will merely drop us a line.

convenience we now offer several complete outfits, packed in handy Tool Chests. These Electric Tool Chests contain a Black & Decker Portable Electric Drill and an assortment of drill bits, auger bits and hole saws, which enable you to drill holes from $\frac{1}{4}$ " to $3\frac{1}{2}$ " in diameter. These Electric Tool Chests are reasonably priced and no mechanic who has to "go out on jobs" can afford to be without one.

BLACK & DECKER

Toronto, Ontario, Canada

TOWSON, MD., U. S. A.

Slough, Bucks, England

Home Comfort Vault for Storing Valuables

in the Basement

How to Build at Low Cost a Fireproof Strong Box of Metal-Lined Concrete

By HAROLD RIDGE



This living room was easily and economically built with Celotex

WHAT a change this basement room is from the usual coal bins, wash tubs, and rubbish heaps!

Celotex makes such transformations possible. Besides changing basements into cheerful recreation rooms you can turn open porches into kitchen additions or sun porches.

You can make waste attic space into a comfortable extra room for the maid or chauffeur, a study for Dad or a den for the boys.

Simple to do

You need only a hammer, nails and saw to make these home improvements yourself, for Celotex comes in big strong boards that are light and easy to apply.

Celotex, made from long tough fibres of cane, stops extreme heat, cold and dampness—makes rooms livable all year 'round.

All reliable lumber dealers can supply Celotex. Send in the coupon below for a free illustrated booklet. The Celotex Company, Chicago, Ill. In Canada: Alexander Murray & Co., Ltd., Montreal.

CELOTEX
INSULATING CANE BOARD

The word
CELOTEX
(Reg. U. S. Pat. Off.)

is the trademark of and indicates manufacture by
The Celotex Company, Chicago, Ill.

THE CELOTEX COMPANY

645 North Michigan Avenue, Chicago, Ill.

Please send me free your illustrated booklet
"Year 'Round Comfort with Fuel Saving."

Name.....

Address.....

City..... State.....



Constructed in a corner of the cellar, this vault protects valuable papers from fire.

NEXT in security to a safety deposit box or a good safe for keeping valuable papers is a fireproof vault like the one illustrated.

It is often necessary for the writer to take valuable papers to his summer home, which is some distance from any bank or trust company. While these papers have no intrinsic value, their loss would entail considerable work and some unpleasantness in business. There was no room for a safe in the house, so the writer constructed an inexpensive fireproof vault. As all the work was done personally and the vault carefully camouflaged by a closet, it is a perfectly safe depository for valuables.

In one corner of the cellar a form 18 in. wide, 20 in. long, and 22 in. high was constructed of $\frac{3}{4}$ -in. lumber. This was simply two sides of a box, the walls making the other two sides. Then a collapsible form 6 by 8 by 16 in. high was built of $\frac{3}{4}$ -in. stock. Strips 16 in. long were nailed $\frac{3}{4}$ in. from each side of the 8 by 16 in. sides. The 6 by 16 in. sides were placed against the strips on the 8-in. sides. To hold the form in the shape of a box, strips were nailed across the top ends and wires run between screw eyes inside the form at the lower end. This form was centered in the first form and held in place by braces.

A third form, 5 in. thick, 12 in. wide, and 14 in. long, was constructed for the top of the vault. This was made solid, and on the bottom was centered and nailed a 1-in. board 8 in. wide and 10 in. long.

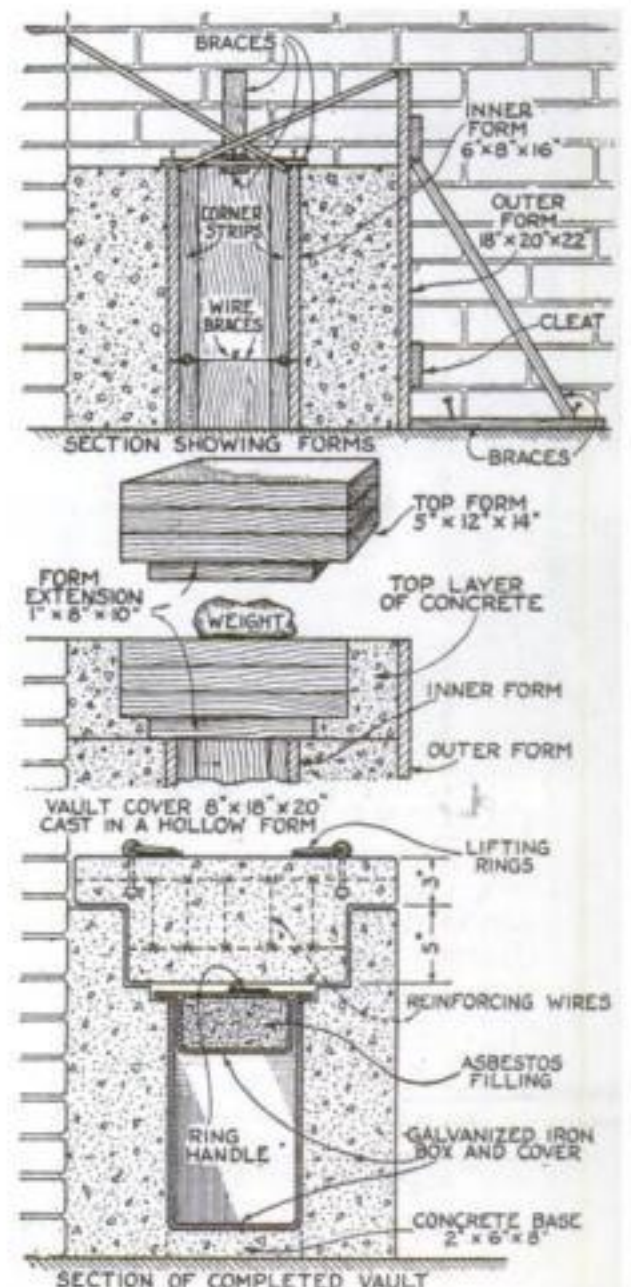
THE second and third forms were greased on the outside, and the space between the first and second form was filled with a concrete mixture consisting of 1 part cement, 2 parts clean, sharp sand, and 4 parts small pebbles. This mixture was worked rather wet and well packed.

As soon as the concrete was level with the top of the center form, the third form was centered on the inner form with the 1 in. section resting on the inner form.

This form was well weighted to hold it in place, and the concrete mixture was poured until level with the top of both forms.

After allowing the concrete to set for from twenty-four to thirty-six hours, the top form was lifted out and the strips and wires on the center form removed so that the form itself could be taken out. The outer form was removed in six days and the vault was allowed to harden for two weeks.

As a lining it was necessary to have a galvanized iron box of a size to fit in the space left by the center form; it might have been made or purchased. For this deep box a top was made of heavy galvanized iron, 8 by 10 in. A 3 in. wide strip of the same material was soldered to the top and bent to fit tightly into the box. The inside of the top was filled with asbestos *(Continued on page 129)*



How the forms are made and set up, and a section showing the metal box and the two covers in place.

Leaky roofs *made good as* New!

THERE is no need now to pay for frequent roof repairs, new roofs or leak damages. No more roof troubles! Rutland No-Tar-In Roof Coating (or Rutland No. 4 Paste) stops leaks instantly—it makes an old roof like new, or a new roof much better.

Rutland No-Tar-In Roof Coating is easy to apply. It requires no mixing, thinning or heating. You can stop the leak as soon as it is discovered.

Does not sag, harden, peel or blister

RUTLAND No-Tar-In Coating provides a perfect roof of asphalt and asbestos—a *tough mineral covering*. Not a drop of tar in it. It will not crawl, sag, harden, peel or blister. It is not affected by acids, rust, decay or corrosion. The coating is elastic—adapts itself to the expansion and contraction of the roof.

Save money—year after year

WITH Rutland No-Tar-In you can keep your roof watertight with minimum attention and maintenance expense. This is property protection at lowest cost! It can be used on every kind of roof (except shingles). There are also over 30 other uses, such as waterproofing foundation walls.

It will pay you to insist upon Rutland No-Tar-In Roof Coating (or No. 4 Paste) at your hardware or paint store. If your dealer hasn't it, mail coupon below.

RUTLAND FIRE CLAY COMPANY
RUTLAND, VERMONT

Also Makers of Rutland Patching Plaster



Rutland

No-Tar-In ROOF COATING

Mail this coupon for complete information

RUTLAND FIRE CLAY CO., Dept. R-25, Rutland, Vermont

Without obligation, please send me more information about No-Tar-In, with name of nearest dealer.

Name.....

Address.....

My dealer's name.....





Pick up the BULL DOG. Heft it. Swing it. Feel its light weight and even balance. Then stack it up against a stiff job that is a real test. Watch this BULL DOG do its stuff!

Use it and ABUSE it. Stall it if you can! Give it a slam-bang trial.

Try the BULL DOG on the hardest, toughest drilling job you can find. If you don't think it's the greatest drill you have ever used, send it back at our expense and we'll return your money.

If your dealer can't supply you, we'll gladly send you one of these biting BULL DOGS direct for a full week's rough-house test.

For quick action, please fill in the blank below, tear it off and mail it to us. We'll rush a BULL DOG to you on the double quick.

7 Big Features

1. Improved Hair-trigger Plunger Switch.
2. Removable Tite-grip, Rubber-covered handles.
3. Non-breakable Foolproof Attachment plugs.
4. S. K. F. Ball Bearings.
5. Not a "special" but Real Heavy Duty.
6. Note Slow Speed, Only 370, Full Load Speed 270.
7. Three-jaw oversized Chuck.

Five Handy Sizes

Note These Low Prices

Bantam.....	3/8"	\$37.00
Bull Dog.....	1/2"	48.00
Big Yank.....	5/8"	64.00
Devil Dog, 2 speed.....	1/2"-3/4"	78.00
Battering Ram, 2 speed.....	3/4"	78.00

Not a "special" but a real HEAVY DUTY DRILL with a full YEAR'S GUARANTEE.

"The Last Word in Drill Perfection."

National Electric Products Co.

Dept. PS-10

140 Baxter Street, New York, N. Y.

Mail this coupon NOW!

Gentlemen:

Please send us the following drills:

(Name) (Size)

@ \$.....

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Check or money order is enclosed. It is understood that this amount will be refunded in full within one (1) week if we decide to return the drill, return expressage being paid by the National Electric Products Co.

Send full information about complete line of drills, drill stands, and vices.

Name.....

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If satisfactorily rated in Dun's or Bradstreet's, Terms are 30 days.

How to Patch Old Furniture That Sheds Its Veneer

By R. C. STANLEY

MANY have the mistaken idea that all veneered furniture is modern. Veneering was done by Chippendale, one of the first of the famous old furniture masters. He did not veneer his furniture to deceive the purchaser and make him believe it to be made of solid wood, but because it was possible to obtain more beautiful grain and a wider range of figures in veneer.

Most veneer, it should be borne in mind, is not sawed, but cut from the log with knives as the log revolves in a huge lathe. The veneer comes from the log like ribbon from a roll and reveals the full beauty of the wood figure. A visit to any well appointed museum will make it clear that many valuable pieces of old furniture are veneered.

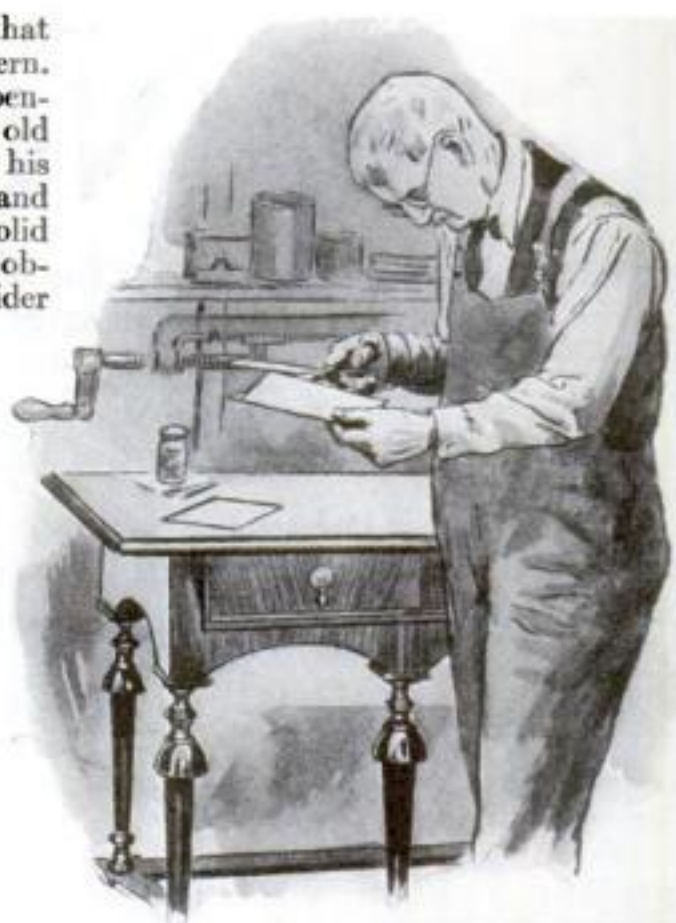
This being true, we are justified in going to great lengths to preserve all the original veneer of antique furniture, especially as it is more difficult to give veneer an artificial appearance of age than it is to antique solid boards.

In veneered furniture the veneer is the original surface, so any veneer which is renewed is considered just that much new material, in spite of the fact that the wood beneath it is old. If a veneered board should be replaced by a solid board, that much of the original construction is regarded as having been altered and the value of the antique is accordingly reduced.

I HAVE worked over pieces in which the material was mahogany, but also veneered in mahogany to obtain the advantage of a more decorative grain. In some cases the veneer has looked hopeless, but to retain the originality of the piece I have had to devise ways and means of preserving at least ninety percent of the veneer. This is a difficult job and requires the patience of Job.

The veneer frequently will be found in small splinters, narrow strips, wide strips, small and large pieces. For the piece to retain its value, this must all be put back. A piece in this condition, provided it is worth restoring, should be sent to an expert; the repairing is so difficult that the beginner, without experience or equipment, cannot hope to do more than make bad matters worse. Ordinary work of this kind, however, is no more difficult than other common repairs.

To replace pieces of veneer, lay them flat, glue side up, and scrape off all the old glue. Do not wet the veneer, as it will expand to a greater size and be too big for its original place. Remove all old glue from the surface on which the veneer is to be replaced and make all preparations for clamping. Use cold glue, that is, liquid glue; this work requires



When furniture veneer is damaged or becomes loose, careful patching or regluing will usually repair it.

speed, but it calls for more speed with hot glue than with cold, as the veneer, being very thin, will expand much faster when hot glue is used. Apply a coating of glue to the board only, not to the veneer. Put the veneer in place and clamp quickly.

Every gluing job is worth exactly what the clamping makes it worth. The amount of glue used has not as much to do with the quality of the joint, as a very thin coating of glue in a properly clamped joint is better than many times the amount of glue in a joint that is improperly clamped. A positive glue joint, made with a good grade of glue, may have the fibers of the wood broken all around it, but the joint itself will not part or break, unless subjected to dampness or conditions such as glue, from its very nature, cannot withstand.

BLISTERS in veneer are caused when the glue gives way in places and air pockets form under the veneer. To heal a blister is a simple operation. With the point of a very sharp knife, make an incision at or near the side of the blister where the glue still holds, and lift the edge of the blistered veneer. Be careful not to make the incision too far from the side where the glue still holds, or the edges will lap when clamped, and I would much rather have the blister to contend with than the lap. Pour enough vinegar in the blister to fill it up, replace the blistered veneer in its position, place the work in such a position that the vinegar will not leak out, leave for about eight hours, and remove any vin-

(Continued on page 136)

The Color Band Inlay on the Cap Identifies the Character of Every Pen Point

Waterman's Number



Red
STANDARD
Suits most writers. A splendid correspondence point. Medium flexibility. For home and general use.

Green
RIGID
Tempered to armor-plate hardness. Will not shade even under heavy pressure. Unequaled for manifold ing. The salesman's friend.

Purple
STIFF—FINE
Writes without pressure. Makes a thin, clear line and small figures with unerring accuracy. Popular with accountants.

Pink
FLEXIBLE—FINE
As resilient as a watch-spring. Fine, tapered point; ground fine to shade at any angle. Loved by stenographers.

Blue
BLUNT
An improved stub point. This point makes a broad line. May be held in any position. Liked by rigid writers.

Yellow
ROUNDED
A different pen point. The tip is ball shape. Makes a heavy, characteristic line without pressure. Suits left-handed writers.

Number Seven
Another example of Waterman's supreme craftsmanship. Ink will not stain this beautiful Ripple rubber pen. Made with attractive lip-guard and an unequalled patented filling device.

\$7.00

Thousands of fountain pen users are turning to Waterman's Number Seven. They are delighted with the ease with which they can select a pen point that exactly suits their style of writing. You will be, too, if you step into a store and ask the pen clerk to let you try the six Number Seven points and select the one that suits you best.

No matter how you write—forward or back-hand, straight or slanting, thin line or broad line, a NUMBER SEVEN will match your style

Why try to suit yourself to a pen point when it is so simple to get a pen point that is made to suit you? The sooner you try Waterman's Number Seven the sooner you will be rewarded with perfect and permanent pen satisfaction.

L. E. Waterman Company, 191 Broadway, New York
Chicago Boston San Francisco Montreal

Use Waterman's INK in Waterman's PENS

Waterman's



For that balky engine

PUT in Eveready Columbia Dry Batteries—their fat, hot sparks are great for starting engines of all kinds—stationary, tractor and automobile, two cycle or four cycle. They make a big difference in cold weather especially. Off the engine goes with a bang, to run steadily for hours on end with never a skip or miss. For exposed engines, use the Eveready Columbia Hot Shot, for its water-proof steel case sheds rain, sleet, snow and fresh or salt water; besides standing abuse.

NATIONAL CARBON CO., INC.

New York



San Francisco

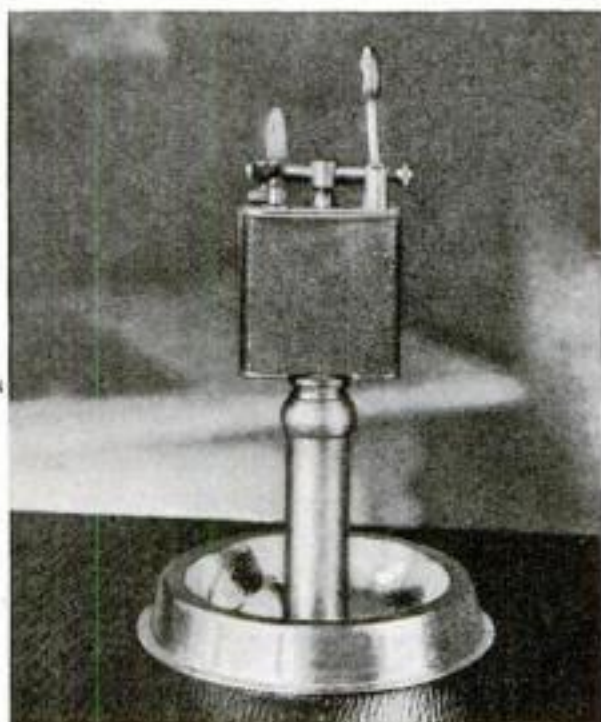
Unit of Union Carbide and Carbon Corporation

**EVEREADY
COLUMBIA
Dry Batteries**
—they last longer

FOR RADIO: Just as the Eveready Columbia is the greatest general purpose cell, the Eveready Dry Cell Radio "A," No. 7111, is the superior cell for this one special use—on radio sets using dry cell tubes. It lasts longer.

Mounting a Lighter to Stand on Your Smoking Table

By Walter E. Burton



The cost for the materials used in mounting this pocket lighter was twenty-five cents.

AN EFFICIENT, attractive lighter for your smoking stand may be made by providing a pocket lighter with a suitable base. The one illustrated, which includes an ash tray, is but a suggestion of the many designs that may be worked out. Its cost for materials for the mounting was twenty-five cents.

The base consists of three parts: a metal ash tray; a piece of $\frac{3}{16}$ -in. brass pipe $2\frac{1}{4}$ in. long, threaded at one end and filed flat on the other; and a brass reducing coupling. The small end of this coupling, which should have outside threads, must be of sufficient diameter so



Parts used for the lighter and ash tray; only the original filler plug was discarded.

that the threads may be filed off and new ones cut to fit into the filling hole of the lighter. The pipe and coupling can be obtained from an electrical supply store.

The stand is assembled by soldering the pipe to the center of the tray and screwing the coupling on the top. As the coupling takes the place of the regular filler plug, the hole in it is soldered shut.

METAL beads used for reinforcing corners of plaster walls are excellent, I have found, for the construction of rails for model railroads. The material can be easily bent and adapted to any layout, and its cost is low.—ROBERT BRAUN.



ANOTHER MEMBER OF THE TELEPHONE FAMILY ~ ~ ~

MANY a radio set has found a new and richer voice in the golden throated Western Electric loud speaker.

Produced by the world's foremost experts in sound transmission—Bell Telephone Laboratories and the Western Electric Company—this loud speaker is responsive both to low bass notes and high treble, reproducing them with fullness of tone and absolute fidelity.

The same engineering skill which developed the telephone has thus removed a serious shortcoming in radio loud speakers.

Here again the name Western Electric is an assurance of mechanical and electrical reliability—whether on loud speaker or on telephone; microphone; public address system; music reproducer; the orthophonic horn and electrical recording for the phonograph; audiometer; audiphone and the talking moving picture. As manufacturers of the nation's telephones, this Company is applying the skill thus gained to making a widening range of communication apparatus.



Western Electric

Purchasers... Manufacturers... Distributors



That Stubborn Beard No Problem Now!

Whiskers come off quick and smooth when small bubbles soak them soft. No drag, no sting or smart. It's a new method of shaving that's very easy to prove by test...see our "no cost" offer in coupon below.



"My, that's smooth!"
she'll surely say.

That's why we're offering a seven-day trial tube free to you and every other reader of this magazine. You'll find the details in coupon below.

Small Bubbles did it!

No other shaving cream is like Colgate's. No other can offer you such unique results. It's a "small-bubble" lather. For small bubbles hold more water. They carry it closer to the base of your beard. A glance at the photographs in the circles proves this better than words.

Note the closely knit, moisture-laden Colgate bubbles. Now contrast that with the large, air-filled bubbles of ordinary lather.



ORDINARY
LATHER

Photomicrograph of lather of an ordinary shaving cream surrounding single hair. Large dark spots are air—white areas are water. Note how the large bubbles hold air instead of water against the beard.



COLGATE
LATHER

Photomicrograph prepared under identical conditions shows fine, closely knit texture of Colgate's Rapid-Shave Cream lather. Note how the small bubbles hold water instead of air close against the beard.



"We always carry it on the boat, sir. Seems as though men all over the world use small-bubble lather."

Good-by, Razor-Pull!

The minute you lather up with Colgate's, two things happen:

1. The soap in the lather breaks up the oil film that covers each hair.
2. Then billions of tiny, moisture-laden bubbles seep down through your beard... crowd around each whisker... soak it soft with water.

In a moment your beard gets moist and pliable... limp and lifeless... scientifically softened right down at the base.

Test it Free, for 7 days

Just jot your name and address on the coupon... and leave the rest to us.

As an extra dividend we'll send a generous bottle of "After Shave," too. It's a brand new shaving lotion that's winning men by thousands!

Colgate & Co., Dept., 500-J, 595 Fifth Ave., New York

Please send me FREE sample of Colgate's Rapid Shave Cream. Also sample of Colgate's After Shave.

Name _____

Address _____

FREE OFFER, MEN!

Governor Improves Ford Motor Used as Power Plant

By J. R. KOONTZ

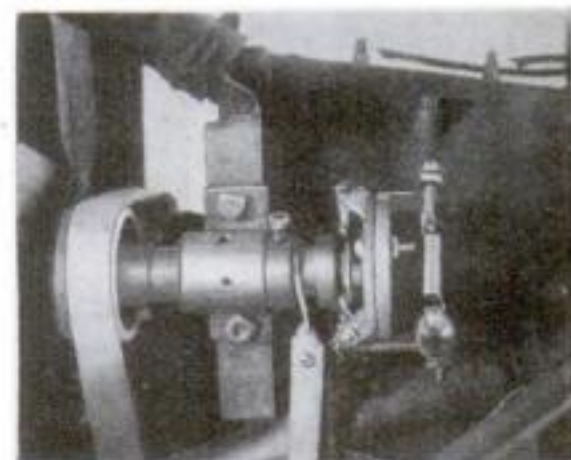


Fig. 1. How the governor is attached and the pulley turned by means of the fan belt.

MOTORS taken from old Ford cars are frequently used as power plants by farmers. The main objection to this type of motor is its irregular speed under various conditions, but this can be overcome by adding a governor.

Obtain a governor of the flywheel type (A, Fig. 2) from a discarded gas engine; usually one can be picked up at a junk dealer's yard. Bolt this to the 4-in. plate B on the end of an 8-in. long transmission shaft taken from a Ford motor. Find a bearing C, preferably 2 in. wide, for this shaft and bolt it to the motor in such a way that when a 4-in. belt pulley D is placed at the end of the 8-in. shaft, it will come in line with the fan pulley (Fig. 1). The fan belt then can be lengthened and used to turn both fan and governor.

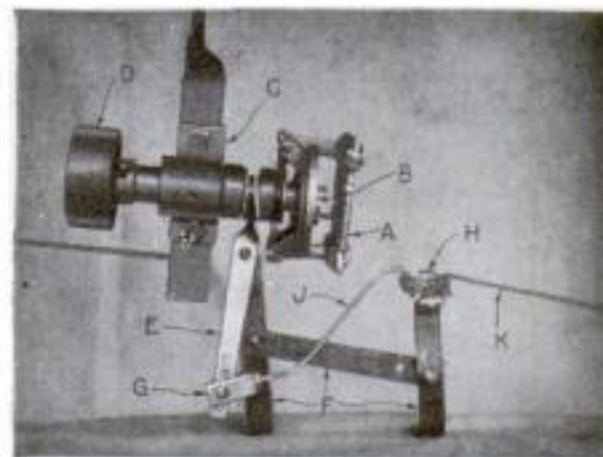
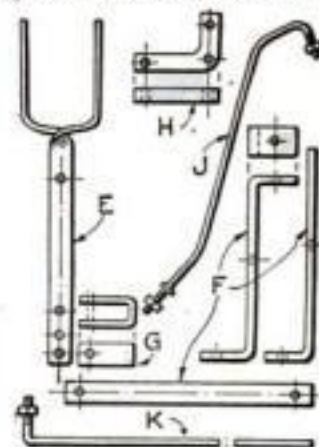


Fig. 2. The parts of the control mechanism, and a photograph of the assembled governor.

The 4-in. plate B has six 1/2-in. holes in it. Two of them, opposite each other, must be sawed out to the edge in order to form openings in which the governor weights can work freely.

The control is obtained, as shown in Fig. 2, by making a lever E with a U-shaped opening at one end to fit over the shaft and in the (Continued on page 100)



A new roommate for the youth of America

School claims them—boys and girls, youth of America. Away they troop, tanned and rested, ready for their classes. Many of these youngsters know the Royal Portable—know it as the friendly, companionable little machine upon which they first learned the magic of changing "a b c's" to words—the thrill of building sentences on paper.

From grade to grade the Royal Portable goes, helping its users to do better work, to win higher marks—making a habit of thoroughness. With its aid, homework of all kinds is neatly and quickly done.

Everyone in the family uses the Royal Portable—father, often far into the night; son and daughter, on college work; and mother, for her correspondence. Light, handy, compact—the simplest and easiest to operate of all small typewriters!

The Royal Portable is made by the makers of the famous standard *Easy-Writing* Royal. It is built to last a life-time and is priced within the reach of all—only \$60, in colors or wood finishes, complete with carrying case. Gradual payments if desired. Prices slightly higher in Canada.



ROYAL
TRADE MARK
**PORTABLE
TYPEWRITER**

ROYAL TYPEWRITER COMPANY, INC., 316 BROADWAY, NEW YORK CITY—BRANCHES AND AGENCIES THE WORLD OVER

tool

facts!

List Prices

DRILL CHUCKS
For 3/8 in. Shaft
No. 757, each \$2.50

For 1/2 in. Shaft
No. 762, each \$3.30

For 5/8 in. Shaft
No. 861, each \$4.00

**SAW ARBORS
AND BUFFING
SPINDLES**

For 1/2 in. Shaft
No. 762, each \$3.30

For 5/8 in. Shaft
No. 862, each \$4.00

BUFFING SPINDLES

For 3/8 in. Shaft
No. 759, each \$1.10
With R.H. Threads

No. 760, each \$1.10
With L.H. Threads

Make Your Motor a Machine Shop!

Get more use out of that small motor which you have. With just a few attachments, you can make many hard jobs easy.

Sawing — Drilling Polishing — Buffing Grinding

To do any or all of these jobs—faster . . . better . . . more accurately—all you need is one or more of the attachments illustrated—of the proper size to fit the shaft of your motor.

Easy to Attach

Made with the care and precision characteristic of all Goodell-Pratt Tools, they fit snugly and are secured by two set screws provided for the purpose.

Your local dealer probably has just what you want in stock; if not, write us.



The Mark of a
Complete Line of
Super-Performance
Electric Drills

GOODELL-PRATT COMPANY *Toolsmiths* GREENFIELD, MASS. U.S.A.

GOODELL-PRATT

1500 GOOD TOOLS

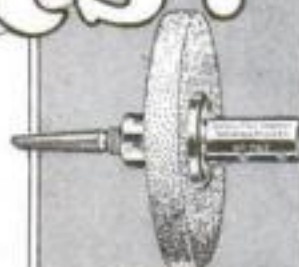


Figure 1

Illustration shows a No. 762 Combination Saw Arbor and Buffing Spindle fitted with a Grinding Wheel.



Figure 2

In this illustration a No. 762 Combination Saw Arbor and Buffing Spindle has been fitted with a saw.



Figure 3

Showing a No. 759 Buffing Spindle fitted with a wire brush.

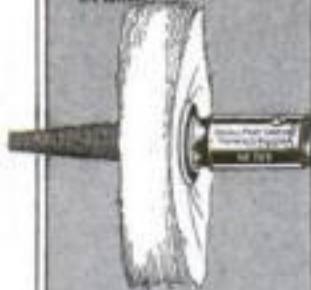


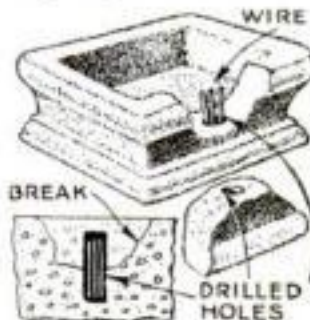
Figure 4

A buffing wheel has been attached to a No. 759 Buffing Spindle.

Mending Broken Concrete Garden Furniture

BROKEN garden furniture, sundials, bird baths and the like, if made of concrete, may be mended, contrary to common belief, so as to make the line of the break even stronger than when the piece was whole.

The fragments should be soaked in water for at least twelve hours. Drill some holes in each piece so that they will face each other exactly in pairs when the parts are put together. If the article is in more than two pieces, it is best to assemble the two largest fragments and, after they are set, add the others one at a time until the whole has been assembled.



How to patch a break in a cement bird bath.

For a drill you may sharpen the end of a discarded or very cheap screw driver. By constantly turning this as you drive it home, you can use it as a star rock drill. The blows should be tempered by cushioning the mallet or hammer with an old piece of burlap or some rags.

When the holes have been drilled, immerse the fragments again in water for a few minutes and fill the holes with soft, freshly mixed, pure Portland cement. Place the larger piece so that the break faces upward and secure it so that it is immovable. Insert a few pieces of fence wire in the soft cement.

Wet the edges of the broken pieces again, smear a thin coat of cement over them, and squeeze them together. Remove the surplus cement and cover with wet rags. It is important that the pieces should not be moved in the least for twenty-four hours.—O. J. W. HANSEN.

Governor for Ford Motor

(Continued from page 98)

groove of the governor so that it will work back and forth as the weights expand or contract. This lever is hinged to a three-piece frame *F*, which, in turn, is fastened to the main frame of the motor.

To the lower end of the lever *E* a heavy wire is fastened by means of a clevis *G*. As the wire is threaded to screw into the clevis, a close adjustment can be made. The wire is carried to one end of an L-shaped arm *H*, which is mounted on the frame. This arm, as shown in Fig. 2, is connected at one end with the wire *J* and at the other end with the rod *K*, which runs to the carburetor.

When carefully adjusted, this contrivance regulates the carburetor and makes a surprising difference in the even flow of power from the motor.

THE efficiency of hot glue depends largely upon the speed with which the joint is assembled, so before gluing be sure that all the necessary clamps are at hand.



Here's Good News

Motorcycle Riders

Modern performance from a distinctly modern machine. Don't look for this new day value in a motorcycle designed two or three years ago. Study these facts if you want the utmost for your money.

IN appearance a vastly better looking motorcycle, in performance a new machine with improvements from end to end.

Motorcycling on this new Indian 4 will be an entirely new sensation. Smooth-flowing power that speaks in a whisper. Four cylinders! Plenty of reserve—twist throttle on the last fifty feet of hill and your sporting blood will tingle at the surge of power that sends you over the top.



Pick-up! With added power, and ingenious redesigning of the transmission, changing second gear ratio



and giving a faster, more positive method of gear shifting, a brand new degree of pick-up has been attained.

And — to balance this pick-up — there are both front and rear wheel brakes. A new, simple foot action on clutch "locks-out" easily in traffic.

Go to your dealer's—take the new Indian 4 for a spin—all by yourself. Stop by the roadside and look at the improved construction. Give it your own private "Road Test." Take the old familiar runs and compare the performance and pleasure with any motor you have ever ridden.

Send coupon for illustrated details. If you don't know the name of your local dealer, ask us.

INDIAN MOTORCYCLE COMPANY
SPRINGFIELD, MASSACHUSETTS

ASK YOUR DEALER
for a Demonstration

The NEW Indian 4

Name..... Age.....

Address

City..... State.....

Send literature on new Indian 4. Give name of nearest dealer..... (check only if unknown to you.)

P. S. 10-28.



HOW TO CLEAN NICHOLSON FILES

There is more than one way to clean Nicholson Files. Sometimes you can remove the particles which accumulate between the teeth of the finer files by rubbing your hand over them or by striking the edge of the file on the bench or vise.

Probably the best method of cleaning any Nicholson File is to use the file brush and the file card.

Cleaning the file at regular intervals with one or the other of these devices will make it last long and do more effective work.

At your hardware or
your mill supply dealer's.

NICHOLSON FILE CO.
Providence, Rhode Island, U. S. A.

— A File for Every Purpose!



NICHOLSON
U.S.A.
(TRADE MARK)

Blueprints for Your Home Workshop

OUR blueprints can be obtained for 25 cents a sheet. In some cases there are two or three sheets to one subject. The blueprints are complete in themselves, but if you wish the corresponding back issue of the magazine in which the project was described in detail, it can be had for 25 cents additional so long as copies are available. Other subjects besides those below are to be had; send a stamped envelope for the complete list.

Popular Science Monthly,
250 Fourth Avenue, New York

Send me the blueprint, or blueprints, I have underlined below, for which I inclose..... dollars..... cents

No.	Title	Described in Issues of	Price
1.	Sewing Table	Feb., '22	25c
2.	Smoking Cabinet	*Mar., '22	25c
3.	End Table	*Apr., '22	25c
5.	Kitchen Cabinet	*May, '22	25c
11.	Bench and Tilt Table	Sept., '22	25c
13.	Tea Wagon	Nov., '22	25c
15.	Workshop Bench	Jan., '23	25c
17.	Cedar Chest	*Mar., '23	25c
18.	Phone Table and Stool	*Mar., '23	25c
19.	Grandfather's Clock	*Apr., '23	25c
21.	Colonial Desk	*Apr., '23	25c
23.	One-Car Garage	*May, '23	25c
27.	Kitchen-Cabinet Table	Oct., '23	25c
30.	Tool Cabinet, etc.	Jan., '24	25c
31.	Sewing Cabinets	Feb., '24	25c
33.	Dining Alcove	Apr., '24	25c
34.	Garden Trellises	May, '24	25c
37.	Simplified Bookcase	Dec., '24	25c
39.	Salem Chest of Drawers	*Feb., '25	25c
41.	One-Tube Radio Set	May, '25	25c
42.	Three-Stage Amplifier	*June, '25	25c
43.	Four-Tube Receiver	*July, '25	25c
44-45.	Pirate Ship Model	*Feb., '26	50c
46-47.	Galleon Ship Model	May, '26	50c
48.	Sailing Yacht Model	*July, '26	25c
49.	Broom Cabinet	Aug., '26	25c
50.	Airplane Model (Rise-off-ground tractor, 36 in.)	*Sept., '26	25c
51-52-53.	Clipper Model, <i>Sovereign of the Seas</i>	*Oct., '26	75c
54.	Five-Tube Radio Set	*Oct., '26	25c
55.	Five-Tube Set—Details	*Oct., '26	25c
56.	Bird and Animal Toys	Dec., '26	25c
57-58-59.	Constitution Ship Model ("Old Ironsides")	Jan., '27	75c
60.	Welsh Dresser	Mar., '27	25c
61.	Viking Ship Model—Hull	Apr., '27	25c
62.	Viking Ship—Details	Apr., '27	25c
63-64.	Toy Motor Boat, 29 in. long hull	May, '27	50c
65.	Six Simple Block Puzzles	June, '27	25c
66.	Ship-Model Weather Vane	Aug., '27	25c
67.	Toy Model of Lindbergh's New York-to-Paris Plane	Aug., '27	25c
68.	Magazine-Rack Table and Book-Trough Table	Sept., '27	25c
69.	Flying Model (3 ft.) of Lindbergh's Monoplane	Oct., '27	25c
70.	Console Radio Cabinet	Nov., '27	25c
71.	Console Cabinet—Details	Nov., '27	25c
72.	Doll's House	Dec., '27	25c
73.	Doll's House Furniture	Dec., '27	25c
74-75-76.	Santa Maria Ship Model, 18 in. long hull	Dec., '27	75c
77.	Simple Pier Cabinet and Decorative Wall Shelves	Jan., '28	25c
78.	Simple Treasure Chests	Feb., '28	25c
79.	Electric Radio Set	Feb., '28	25c
80.	High Power Unit for Electric Radio Set	Mar., '28	25c
81.	Low Power Unit for Electric Radio Set	Apr., '28	25c
82.	Simple Single-Stick Airplane Model (30-in.)	Mar., '28	25c
83-84-85.	Mayflower Model	Apr., '28	75c
86.	Racing Airplane Model (35-in. twin-pusher type)	May, '28	25c
87.	Seaplane Model (30-in.)	June, '28	25c
88.	Simple Modernistic Stand; Modernistic Bookcase	Aug., '28	25c
89-90.	Bremen Scale Flying Model (3-ft.)	Aug., '28	50c
91.	Modern Folding Screens	Sept., '28	25c
92.	Simple Baltimore Clipper Ship Model (8 in. long)	Sept., '28	25c
93.	Three Modern Lamps	Oct., '28	25c

*Magazine only out of print.

Name.....
(Please print name and address very clearly)

Street.....

City and State.....

PLASTIC WOOD

Trademark Reg. U. S. Pat. Off.

Wood that you can mould. It comes from the can like putty and can be readily applied with the fingers or a knife for many household needs, as described below.



When hard, it can be chiselled, sawed, planed and holds nails, tacks and screws. It takes paint, varnish and lacquer, and adheres firmly to wood, metal and other material.

Furniture Repairs



Loose drawer pulls can be permanently replaced or tightened by forcing Plastic Wood in the socket, and if desired, forming a knob on the inside. Dents can be filled; chipped mouldings built up; loose joints tightened with Plastic Wood. Scrape surface clean before applying. When hard, sandpaper smooth. Paint or stain.

Mouse Holes

Mouse or rat holes can be effectively sealed with Plastic Wood. First, fill around the edges with Plastic Wood. As this hardens fill the center slightly above the surface of the floor or wall and shape to match mouldings. When hard, pare level with a knife or plane and sandpaper smooth. Paint or varnish to proper color.



Under Linoleum

Linoleum may crack if laid over boards that are worn, or with raised edges. Before laying linoleum, smooth off sharp edges, build up all worn spots on the floor with Plastic Wood, and fill in wide cracks between boards. Thoroughly clean the floor before applying. When the Plastic Wood hardens sandpaper it smooth.



Cracked Porcelain

For example, with a cracked toilet tank, draw off the water, allow crack to dry thoroughly, and with a putty knife force Plastic Wood firmly into the crack from the inside, allowing it to overlap the edges of the crack. Let it harden before filling tank. Cracked or chipped porcelain handles can also be repaired with Plastic Wood.



For Broken Toys



Toys which crack or break apart can usually be firmly repaired with Plastic Wood. Carefully scrape away paint or dirt where Plastic Wood is to be applied, in order to have it hold firmly. Lost pieces of the toy can be built up; doll's heads can be affixed; loose handles attached; broken parts re-joined, and splinters or holes filled in.

Automobile Repairs

Body dents can be eliminated by scraping clean, filling with Plastic Wood and sandpapering smooth; paint or lacquer. Screw, rivet or bolt holes can be made to again hold hinges or other wrenched off parts. Rotted or split top bows repaired; loose fixtures made tight. Dirt, grease or paint must be scraped away before applying.



Loose Tiles

Plastic Wood affords the quickest and simplest means of replacing a loose tile in bathroom or kitchen. Apply around the edges of the tile, and (if it is entirely out) to the back as well. For door stop or other fixtures that have come loose from tile floor or walls, Plastic Wood will form a new base in the old hole for holding the fixture.

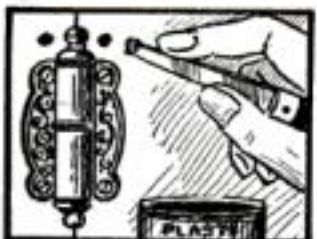


Electrical Insulation

Plastic Wood is recommended for filling in holes around electrical apparatus and other places where a workable substance is required that will harden and remain so. It has a volume resistivity of 1012 ohm-centimeters, a hundred times greater than mica. Attached to plier handles or other tools it furnishes a desirable insulated grip.



Screw Holes



When hinges, or other fixtures, must be moved from woodwork, (as with screen doors) Plastic Wood will completely fill the old cavity with solid wood. Force it in the hole, allow to harden; sandpaper smooth and paint if desired. Plastic Wood is superior to wood plugs in that it will fill any shaped cavity completely.

Plugs in Concrete

Where it is desirable to lay carpets on concrete stairs, affix matting or carpet to concrete floors, hang pictures or fixtures on concrete or plaster walls, holes can be drilled into the concrete and filled with Plastic Wood, giving a wooden base into which tacks, screws, nails or hooks can easily be fastened.



Plastic Wood is carried at Hardware and Paint Stores, and by ship Chandlers. It comes in natural wood color in 1 lb. cans at \$1.00, and in 1/4 lb. cans at 35 cents.

PLASTIC WOOD

Reg. U. S. Pat. Off.

Manufactured by The Addison-Leslie Company, 308 Bolivar Street, Canton, Mass.

Handles Like Putty

Use Plastic Wood Solvent for softening Plastic Wood when it hardens too rapidly. Ask your dealer for it. Solvent cannot be shipped by mail.



Hardens Into Wood

For bathroom tile cracks, loose tiles or cracked porcelain ask for Plastic Wood White Waterproof Tile Cement, specially prepared for this use.

ATKINS SILVER STEEL SAWS

for Your
HOME
Workshop



A splendidly-equipped home workshop like this is a source of great pleasure and profit to men who like to make things. Have you a workshop, or set of good tools in YOUR home?

GOOD SAWS for the Man Who Makes Things!

YOU'LL get far more fun and satisfaction in making things in your home workshop, if you use ATKINS Saws. They help you do any job of cutting wood or metal faster, easier and better; save you time, effort and material!

To see "ATKINS" on a saw is to know that it is the highest quality and value you can buy. For, only ATKINS Saws have "Silver Steel" to hold a sharp cutting edge longer. Only an ATKINS is "Segment Ground" to make your saw cut easily without binding. And only ATKINS Saws are fitted with "Perfection Handles" to eliminate all wrist strain.

Your Hardware Dealer can show you ATKINS Saws for every purpose. Insist on an ATKINS—you'll find it the best tool investment you ever made.

Valuable Saw Booklets—FREE!

Send the coupon below for these two practical booklets. You'll find them of real help in buying and using saws.

ATKINS Saws and Tools for Your Workshop

No. 53 Hand Saw . . . No. 53 or No. 51 Rip Saw . . .
Coping Saw . . . Compass Saw . . . No. 2 Back Saw . . . Nest of Saws . . . Hack Saw Frame . . . "Silver Steel" Hack Saw Blades . . . Handy Saw . . . Scraper Blades . . . Slim Taper Files . . . Mill B. Files . . . Saw Set.



E. C. ATKINS & CO. Est. 1857

428 So. Ills. St., Indianapolis, U. S. A.

Leading Manufacturers of Highest Grade Saws for Every Use;
Saw Tools, Saw Specialties, Plastering Trowels,
Machine Knives, Grinding Wheels and Files



Please send me your Free Books, "SAW SENSE" and "SAWS IN THE HOME."

Name.....

Address.....

My Dealer Is.....

Wins Three Prizes with Our Models

TWO first prizes and the grand prize in a Boy Scout handicraft exhibition at Galesburg, Ill., were won by 14-year-old Glade Wilcox, with the models illustrated. One is a 3-ft. flying scale model of the *Spirit of St. Louis*; the other is a model of the *Sovereign of the Seas*, a famous clipper ship. Both were made from plans published in POPULAR SCIENCE MONTHLY.

Working drawings of these models are available in the POPULAR SCIENCE



Glade Wilcox, a Boy Scout of Galesburg, Ill., with winning airplane and ship models.

MONTHLY series of blueprints—the Lindbergh plane in Blueprint No. 69, and the clipper ship in Blueprints Nos. 51, 52, and 53 (see the list on page 102).

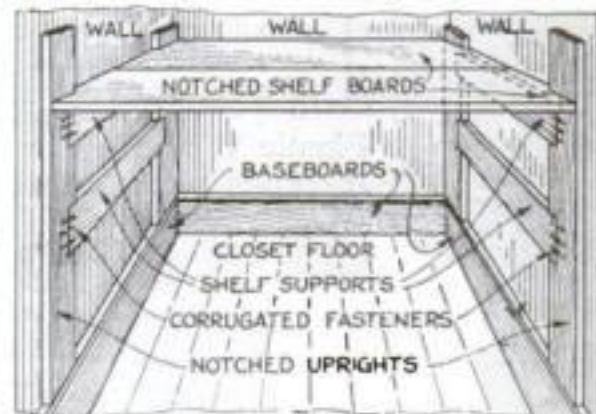
The fact that Glade was so successful in building such advanced models as these is clear indication that no one who has a reasonable amount of ingenuity, persistence, and liking for craft work need hesitate to undertake their construction.

In his letter, Glade says:

"I made the models under the supervision of my father, who showed me where my mistakes were and tried to get me to do it right. I am a second-class scout, in the eighth grade at school, and president of the Mohican Pioneer Club."

Shelves Set Up Without Defacing Closet Walls

BY THE method illustrated, shelving can be installed in the closets of a rented apartment or house without defacing the walls. The shelves can be readily removed at any time. Two



The shelves rest upon two ladderlike frames put together with corrugated fasteners.

supports are assembled as shown with corrugated fasteners, which can be obtained at any hardware store. The shelves then are notched at the corners and fitted in place.—F. M. D.

Have you tried it AFTER SHAVING ?



**EXHILARATES!
COOLS!
PROTECTS!**

AFTER your next shave, douse Listerine on the face full strength.

What a nice reaction. Cooling! A new sense of vigor and freshness. Amazing stimulation for tired skin. And all the usual smarting and burning gone at once. Also you have the satisfaction of knowing that the antiseptic essential oils of Listerine are enemies of infection.

One trial of Listerine this way will win you. Why not today? Lambert Pharmacal Company, St. Louis, Mo., U. S. A.

Have you tried
the new Listerine
SHAVING CREAM?

Cools your skin while you shave
and keeps it cool afterward.
An outstanding shaving
cream in every respect.

L I S T E R I N E

THE SAFE ANTISEPTIC

OIL HEAT—AS BENEVOLENT AS SUNSHINE



Oil heating convenience —starts at the curb

THE oil truck stops a few minutes in front of your house. When it drives on, your oil tank, hidden underground, is refueled. You are not disturbed in any way.

This simple, silent, clean procedure is typical of the entire carefree operation of your oil heating system.

From the tank the heater takes oil as needed to keep the temperature uniform. Practically the only indication you have that you possess a heating system at all is that the rooms are always comfortable, night and day.

Your basement is clean. There is space for a work bench or playroom. The entire house is free from grime and dust.

Thousands of home owners each year are proving for themselves that no other modern convenience contributes so much to the comfort and health of the entire family as oil heating.

Why not prepare for winter by installing an oil heater in your home now? In this way you can enjoy its even temperature during the trying days of fall when ordinary artificial heat keeps the house either too warm or too cold, and you will be ready for the incomparable convenience of oil heat in the winter days to come.

For your guidance, the Oil Heating Institute has published a series of non-technical books written by authorities on domestic oil heating. The coupon will bring you the book you want. Mail it today.

OIL HEATING INSTITUTE

420 Madison Avenue

New York

- 1 *The Oil Heating Institute is prepared to furnish special information on the heating of churches, theatres, hotels, apartment houses and office buildings, and on the various heat treating processes of industry.*



This is the Emblem of the
Oil Heating Institute

It is the symbol of satisfactory public service in oil heating.

Only the manufacturers who are members of the Oil Heating Institute are permitted to use it.

These manufacturers have earned their membership through the enthusiasm of thousands of home owners whom they have provided with efficient and dependable oil heat.

This emblem protects you, and it will be protected, on your behalf, by the Oil Heating Institute.

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MAIL
THE COUPON
TODAY!



OIL HEATING INSTITUTE
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Please send me, free of charge, the following information on oil heating equipment:

Does it Pay to Install an Oil Heater?.....
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P.S.—10



Home Workshop Chemistry

*Simple Formulas that
Will Save Time
and Money*

ONE of the simplest yet most valuable chemical tests which the handy man or scientifically minded boy can perform at home is to determine if there is sulphur in gasoline. Sulphur in gas burns in the motor to sulphuric acid vapor, which corrodes and pits the valves and other accessible surfaces. Therefore it is worth the while of the auto owner to know positively the amount of sulphur in the gas from his favorite service station.

The apparatus needed to perform the test is (1) a small bottle, (2) a wash basin or similar receptacle, (3) a thermometer reading to 122° Fahrenheit, and (4) some thin pure copper sheet, such as can be bought cheaply from a chemical supply house, or can be hammered in the workshop from pure copper wire. Trim a piece to about ½ by 3 in. and polish it brightly.

The copper strip, trimmed and polished, is placed in the bottle and covered with the gasoline to be tested. The bottle is loosely stoppered and set upright in the basin. Now pour enough lukewarm water into the basin to reach slightly above the level of the gasoline and form a water jacket, in order to regulate the temperature of the reaction between the sulphur in the gasoline, if any is present, and the copper strip.

Set the bulb of the thermometer in the water, place the basin containing the water and the bottle of gasoline on the back and relatively cool part of the kitchen stove, and then, by moving the basin back and forth, find the place where the temperature will remain at approximately 122°. Leave the apparatus at this temperature point for three hours.

Quoting from the U. S. Navy Department specifications for testing gasoline, the "presence of sulphur or corrosive compounds is indicated by the corrosion or discoloration of the gasoline-exposed strip" of copper. In other words, if the polished surface of the copper has turned to a characteristic dirty reddish brown (due to the formation of copper sulphide) by the end of three hours, the gasoline contains sulphur in an amount which would make it corrosive in a gasoline engine. Ignore only a slight darkening of the copper.—W. H. HAMMOND.

INK spots usually can be removed from woodwork with a strong solution of oxalic acid. Prepare the solution by dissolving oxalic acid crystals in water until no more will dissolve. If several applications do not cause the stains to disappear, apply the acid once more and add some chlorinated lime immediately. Should this fail, try repeated treatments with phosphoric acid of fifty percent strength. Be sure to remove all traces of the chemicals from the surface with water and allow the wood to dry before attempting to refinish it.

New Electric Toolshop



**MILLERS FALLS
TOOLS**

SINCE
1868

DRILLS · TURNS · GRINDS SAWS · SANDS · BUFFS · POLISHES

PPROMISE yourself a big new thrill with this New Electric Toolshop. You won't be disappointed. It has energy and reserve power beyond anything you've ever expected in a home workshop.

It's the Toolshop you've always wanted but have never been able to find . . . a man-sized outfit with a motor that doesn't lie down on the job.

NOW — "making things" becomes easy and fast — furniture, lamps, cabinets—all sorts of wood and metal-turning jobs—toys, boats, garden trellises, magazine and pipe racks — hundreds of useful and fancy articles of wood and metal — easy to make with this power Toolshop. Your hands don't tire and lose their accuracy.

Big labor-saver 'round the house and garage — 5 seconds to de-mount the power unit and you have a sturdy electric drill that takes all the toughness out of household repair jobs, removing carbon from your automobile — grinding, buffing, and polishing.

Drilling metal takes seconds or minutes, instead of half hours or hours.

The New Electric Toolshop is 36" long and 10" high, attractively enameled in red and black. Comes packed complete, except lathe-bed, in steel carrying-case 9 x 16½ x 7½", equipped with leather handle and strong hasp fastener.

See it at your hardware dealer's. Compare it with any other workshop on the market—at any price. You'll be amazed at its sturdy quality and low price.

Only \$68⁰⁰

including steel carrying-case

If your dealer cannot supply you, write for name of one who can. Address, MILLERS FALLS CO. Millers Falls, Mass.

The New Electric Toolshop includes:

¾" Standard Electric Drill (power plant) with 8' of cable and socket.

34" Lathe-Bed, with Head and Tailstock

Rest Socket Long Rest
Short Rest 2 Pointed Centers

1 Spur Center 1 V Center

1 Face Plate Center

1 Cup Center 1 Screw Center

1 Adaptor 1 Chuck and Shank

1 Face Plate 1-4" Emery Wheel

1-6" Wire Brush

1-6" Buff Wheel

1 Wire End-Brush

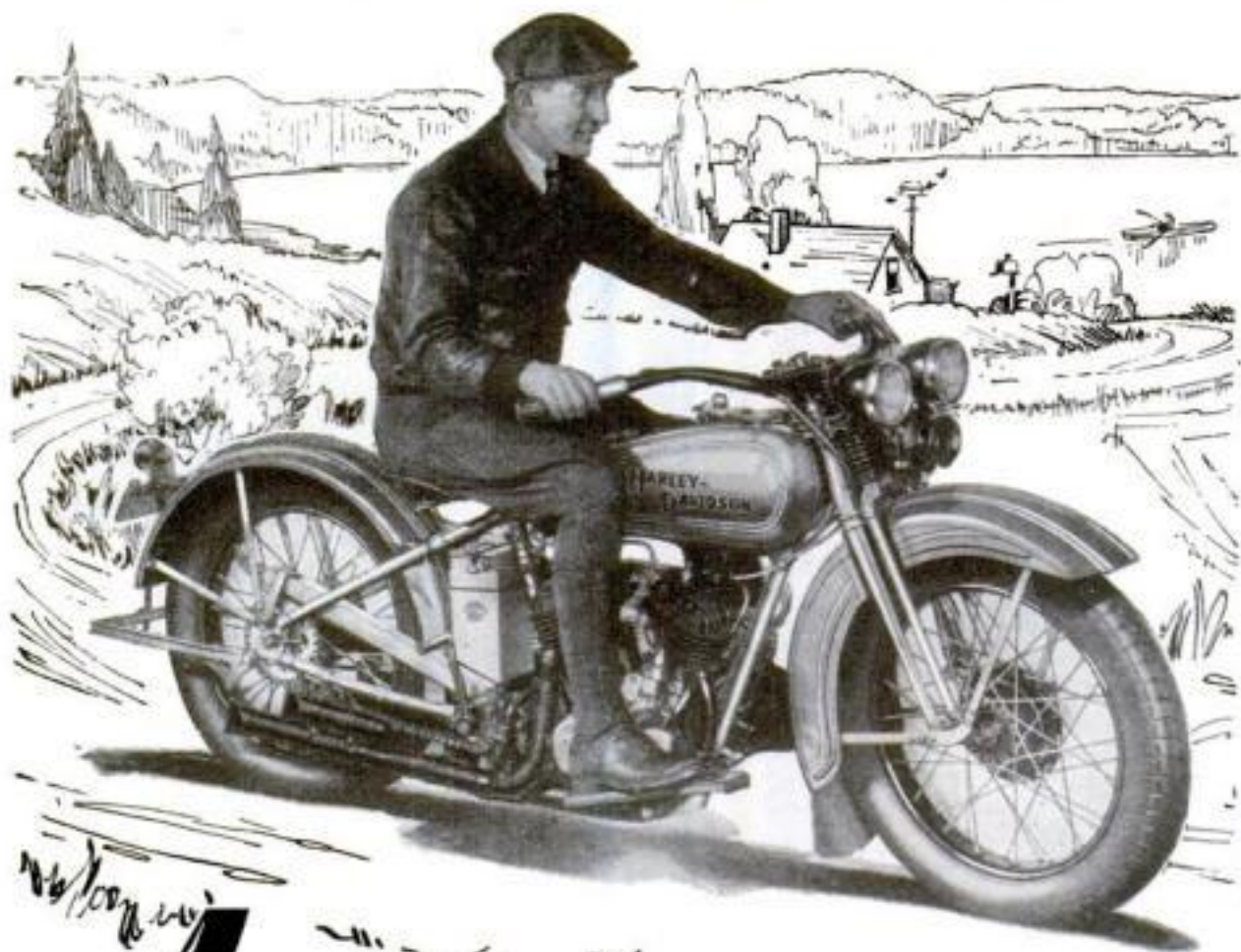
4 Turning Tools 1 Wrench
Steel Carrying-Case

11"x12" Saw Table including 6" Saw and Arbor—\$10.00 extra.

MILLERS FALLS
COMPANY

MILLERS FALLS
New Electric Toolshop

MILLERS FALLS
MASS.



A New HARLEY-DAVIDSON

NEW, from trim double headlights to broad, crowned mudguards—the "45" Twin! It's the very model that the motorcycle world has been waiting for—lighter than the Big Twins, but wonderfully smooth-running, powerful, and fast enough to pass any mile-a-minute car.

Ride out on this latest Harley-Davidson—over highway or trail—and see for yourself what a marvelous performer it is. Then wonder how it can be sold at the low price of \$290 f. o. b. factory.

Ask your dealer about his Pay-As-You-Ride Plan. Mail the coupon for new literature.

HARLEY-DAVIDSON MOTOR COMPANY
Dept. P. S. Milwaukee, Wis.

The 1929 Single

—has all the 5 Big Features above, plus its famous 80-miles-per-gallon economy. Sells complete at \$235, f. o. b. factory.



Mail the Coupon

5 BIG FEATURES

- 1 **Two Bullet Headlights**
Double lights—greater safety.
- 2 **Generator Controller**
Quick, handy control of current output.
- 3 **Electrical Panel . . .**
Includes ammeter, parking light, and switches.
- 4 **4-Tube Muffler . . .**
Makes exhaust wonderfully quiet.
- 5 **Clear-the-way Horn**
High-frequency—penetrating, pleasing note.

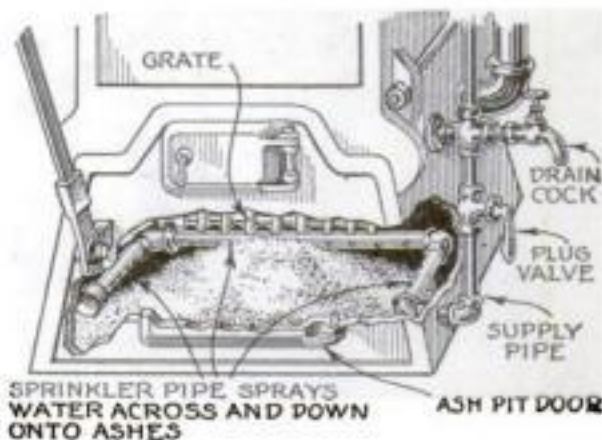
Ash-Pit Sprinkler Reduces Dust in Cellar

By Charles B. Carlon

WITH the starting of the house furnace in the fall comes the ash dust nuisance. Every time the ashes are removed, an impalpable and penetrating white cloud spreads through the cellar and often enters by devious cracks into the living-rooms above. The dust is particularly annoying to the man who takes pride in a cellar workshop, and it is always a source of work for the housewife.

To reduce the dust to a minimum it is necessary merely to place a sprinkling system in the ash pit of the heating plant. My own installation proved so practical that all my acquaintances have made similar sprinklers, if for no other reason than to keep the dust out of their hair and off their clothes.

A water pipe with many fine spray holes in it is fastened to the side walls of the ash



Sprinkling system placed directly beneath the grates to dampen the ashes before removal.

pit directly beneath the grates. The shape or size of the furnace makes no difference, as the pipe can be cut and bent to suit.

In my own case the installation is as illustrated. Holes are drilled in the pipe at intervals of about 1½ in. with a No. 50 drill. The pipe is turned in the assembling so that the holes, which are in a straight line, will throw a stream across and down. In this way the whole bottom of the pit is certain to be dampened.

The pipe is held in place with strap fasteners. Ells are used where necessary, and an ell and a close nipple are used in carrying the line through the side of the ash pit. The connection with the supply pipe is made by means of a union on the outside. This arrangement allows one to work from the end of the line, which should be closed, of course, with a cap, back to the supply pipe. A valve is put in the water supply line near the furnace; for a ½-in. line a lever-handle stopcock is convenient.

The sprinkler should not be operated when the ashes are hot because steam would be generated and unnecessary dust caused. My method is to shake the fire in the morning and during the day, as necessary, and then, before making up the fire at night, to sprinkle the cold ashes and remove them. It is merely a matter of forming the habit of removing ashes before shaking instead of after.

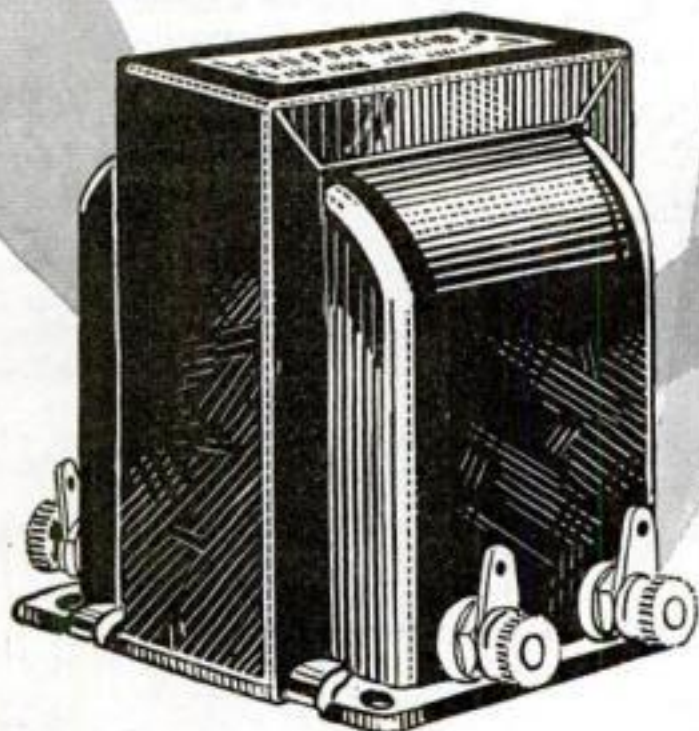
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A NEW NOTE IN AUDIO AMPLIFICATION



THORDARSON R-300 AUDIO TRANSFORMER

SUPREME in musical performance, the new Thordarson R-300 Audio Transformer brings a greater realism to radio reproduction. Introducing a new core material, "DX-Metal" (a product of the Thordarson Laboratory), the amplification range has been extended still further into the lower register, so that even the deepest tones now may be reproduced with amazing fidelity.

The amplification curve of this transformer is practically a straight line from 30 cycles to 8,000 cycles. A high frequency cut-off is provided at 8,000 cycles to confine the amplification to useful frequencies only, and to eliminate undesirable scratch that may reach the audio transformer.

When you hear the R-300 you will appreciate the popularity of Thordarson transformers among the leading receiving set manufacturers. The R-300 retails for \$8.00.

THORDARSON ELECTRIC MANUFACTURING CO.
Transformer Specialists Since 1895
WORLD'S OLDEST AND LARGEST EXCLUSIVE TRANSFORMER MAKERS
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Power Supply Transformers

These transformers supply full wave rectifiers using two UX-281 tubes, for power amplifiers using either 210 or 250 types power amplifying tubes as follows: T-2098 for two 210 power tubes, \$20.00; T-2900 for single 250 power tube, \$20.00; T-2950 for two 250 tubes, \$29.50.



Double Choke Units

Consist of two 30 henry chokes in one case. T-2099 for use with power supply transformer T-2098, \$14; T-3099 for use with transformer T-2900, \$16; T-3100 for use with transformer T-2950, \$18.



Power Compacts

A very efficient and compact form of power supply unit. Power transformer and filter chokes all in one case. Type R-171 for Raytheon rectifier and 171 type power tube, \$15.00; Type R-210 for UX-281 rectifier and 210 power tube, \$20.00; Type R-280 for UX-280 rectifier and 171 power tube, \$17.00.



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A complete line of transformers to couple either single or push-pull 171, 210 or 250 power tubes into either high impedance or dynamic speakers. Prices from \$6.00 to \$12.00.



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The Thordarson Z-Coupler T-2909 is a special impedance unit designed to couple a screen grid tube in the audio amplifier into a power tube. Produces excellent base note reproduction and amplification vastly in excess of ordinary systems. Price, \$12.00.



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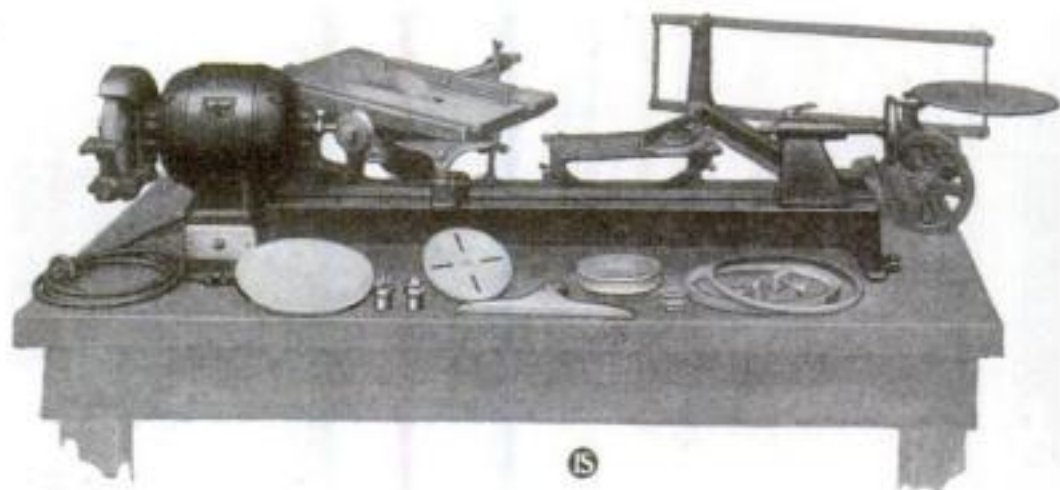
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Mail the coupon for fully illustrated descriptive circular and prices on Ar-Con Utilitool and individual units.

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Please mail complete description and prices of Ar-Con Utilitool.

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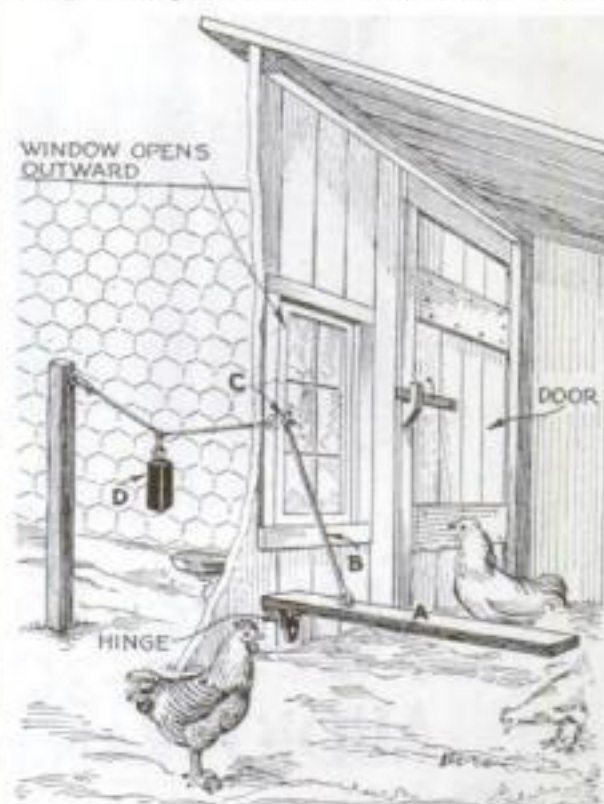
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Automatic Door Lets Hens Out Early

SUBURBANITES and others who have a few chickens and keep them locked up at night usually find it inconvenient to get out of bed at daybreak to let them out of the chicken house. The chickens, however, can let themselves out if a door or window is fitted with the automatic release illustrated.

The weight of the first chicken to step on the pedal *A* in the morning withdraws the hook *B* from the eye *C*, and then the weight *D* opens the door outward. Unless



When the chickens stir at daybreak, they depress pedal *A*, and the window opens.

there is some unusual disturbance, the chickens will not leave their roost until dawn, so that once the door has been fastened with hook *B* it will stay shut through the night.

The only materials needed are one board for the pedal from 3 to 6 in. wide and of any suitable length, one hinge, four screw eyes or staples, one piece of wire for the hook *B*, one post, a weight, and a length of chain or rope.

A device of this type installed by me in 1924 still functions daily. It has been elaborated upon by some of my friends to the extent of making the chickens feed themselves. The feed is placed in a receptacle in such a position that it is dumped out as the window swings open.

Any chicken house in which this device is installed must, of course, also have a regular door through which one can leave after the trap is set.—R. C. S.

Coloring Ship Model Chains

FINDING it difficult to paint ship model chains black, I use this simple method of coloring them: If the chain is copper, I dip it in an easily prepared solution of 1 oz. liver of sulphur or potassium pentasulfide to 16 oz. of water, which oxidizes the metal and produces a black color of a pleasing appearance. If the chain is brass or iron, it is first copper-plated and then treated in exactly the same way.—L. E. SMITH.

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Leader of the gangs. Built for strength as well as beauty. Die-cast frame. Free moving rotor. Sections accurately matched to within $\frac{1}{4}$ of 1% (plus or minus).

Recesses in the frame permit the direct attachment of Hammarlund Equalizing Condensers for utmost precision.

Made in 350 mmfd. and 500 mmfd. sizes, with two, three and four gangs operating on a single shaft.



For the Short-Wave Fan

Plug-in Coils covering the short-wave bands from 8 to 215 meters.

Space-wound, giving extremely low resistance. Widely spaced plug-in terminals. Adjustable primary, held in any position by friction.

The standard three-coil set (illustrated) covers the popular range from 15 to 107 meters. Other coils available for higher or lower wavelengths.

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Embossed bronze escutcheon of unmatched beauty. A mechanism that would delight a watchmaker.

The control knob is uniquely planned to be placed in any position on the panel desirable for attractive balance.

Numbers and degrees illuminated from the back by a small electric bulb connected with the "A" battery.

THE parts used in your receiver are more important even than the circuit. Circuits change little. Most of them give good results. But parts have improved greatly because it is the parts that give you the quality and refinement demanded of modern radio.

Your receiver can be no better than the poorest part in it. Follow the lead of the world's foremost radio engineers—use Hammarlund Parts and be sure.

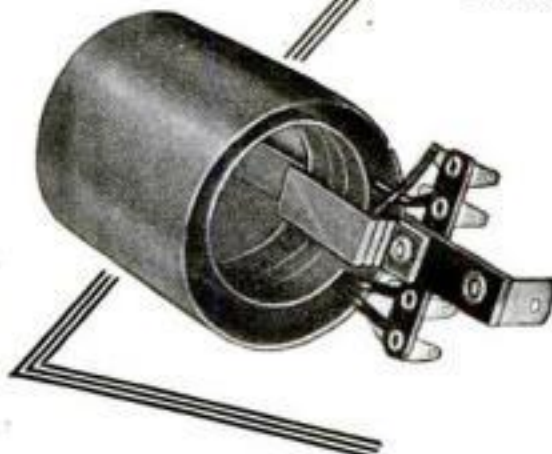
Unique Mechanism



Back View of
Drum Dial
Showing Mechanism

The driving mechanism employs an exceptionally strong silk and linen cord, gripping a drum, snubber fashion. It cannot slip—absolutely no back lash or lost motion.

Thoroughly tested for wear under actual working conditions, this cord withstood 36,600 full-range movements of a large multiple condenser without stretching, fraying or breaking. It will never receive similar treatment in normal use.



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For use with the popular shield (or screen) grid tubes.

Exceptionally efficient low-resistance, space-wound, self-supporting inductance, 2 in. in diameter.

A high-impedance primary with three taps for desired pick-up and selectivity.

Antenna coupler and R. F. transformers for use with either .0005 mfd. or .00035 mfd. condensers.

Vertical mounting lug. Fits in small space. Convenient soldering terminals.

Equalizing Condenser

A small neutralizing or balancing condenser of wide capacity range. Useful as a compensator for equalizing the units of a multiple-tuning condenser. May be attached directly to socket binding posts or condensers. Small size—fits limited space. Bakelite base, mica dielectric, heavy phosphor-bronze spring plate. Movement of center screw gives gradual capacity changes.



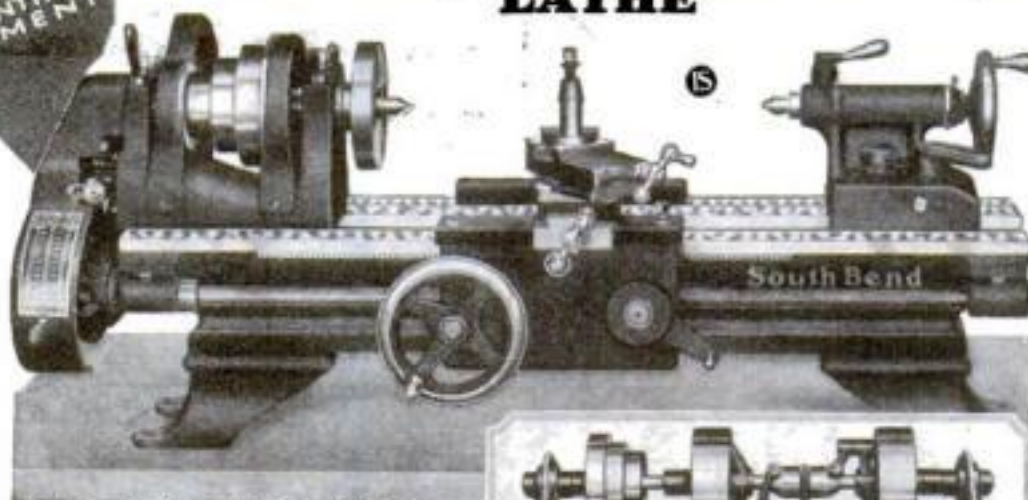
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Price \$155—Weight 375 lbs.

We ship Lathe immediately upon receipt of small down payment, and give you 10 months to pay balance in equal installments. With each Lathe we send Free Complete Instruction Book "How to Run a Lathe."

Prices and Terms of 9-Inch Junior Lathes

Size Lathe	Between Centers	Weight	Down Payment	Monthly Payment	Price Lathe
9" x 2½'	11 in.	350 lbs.	\$30.00	\$12.00	\$150.00
9" x 3'	18 in.	375 lbs.	31.00	12.40	155.00
9" x 3½'	23 in.	400 lbs.	32.00	12.80	160.00
9" x 4'	29 in.	425 lbs.	33.00	13.20	165.00
9" x 4½'	36 in.	450 lbs.	34.00	13.60	170.00

Use Your Lathe While Paying for It

You can install any South Bend Lathe by making a small payment with your order and take care of the balance in small monthly payments over a period of ten months. We ship as soon as the down payment is received.

This new Easy Payment Plan brings you the opportunity to install an income-producing Lathe at our low factory prices, and we help you finance the purchase. You get the equipment you need to give better service to your customers, and the new business should more than take care of the monthly payments.

Prices and Terms on Other Popular Sizes

Size of Lathe	Weight	Down Payment	Monthly Payment	Total Price
11" x 4' Quick Change Gear	725 lbs.	\$ 67.00	\$26.80	\$335.00
13" x 5' Quick Change Gear	1110 lbs.	80.40	32.16	402.00
18" x 8' Quick Change Gear	2640 lbs.	140.00	56.00	700.00
32" x 5' Brake Drum Lathe	1225 lbs.	95.00	38.00	475.00
36" x 6' Brake Drum Lathe	2160 lbs.	130.00	52.00	650.00

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| <input type="checkbox"/> 13-inch Lathe | <input type="checkbox"/> Brake Drum Lathe |

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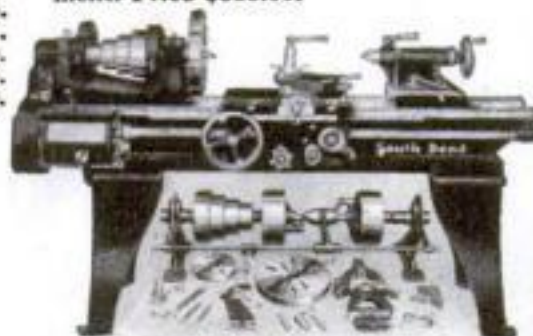
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for this 16" x 8' New Model Quick Change Back Geared Screw Cutting Lathe with Countershaft and Regular Equipment—Price \$570.00.

Candlestick Turning Reduced to a Few Simple Steps

By HERMAN HJORTH



Fig. 1. After the base has been trued with a round-nosed chisel and smoothed with a square-nosed tool, it should be tested for flatness.

THOSE who have followed the previous articles in this series have, I am sure, acquired a certain measure of skill and confidence with wood-turning tools by this time. They will find faceplate turning, the next phase of the work, not more difficult than spindle turning; and no set of exercises need be mastered before real work can be attempted.

The tools are the same as those described in the first article (March, 1928,



Fig. 2. Making the base circular by removing wood from the edge with the toe of a skew chisel. Note position of the T-rest.

page 98), and the methods of using them do not differ materially from the ones employed in spindle turning.

By mastering faceplate turning, you can make candlesticks, lamps, smoking stands, frames, rings, boxes, trays, and bowls. These projects, of which two are described in detail in this article, can be turned only by the use of chucks and faceplates.

A candlestick (Continued on page 114)

These Boice Bargains Can't Be Beat

Send 10c in stamps or coin for Boice's latest catalog, describing the finest collection of Bench Woodworking Machines ever offered. Boice-Crane Bench Circular Saws, 14-inch Band Saw, 4-inch Jointer, Lathes, Jig Saw, and Books of Designs.



\$30.00 Universal Handisaw
Table elevates for grooving. Cuts 2½-in. stock. Takes 6x1-in. dado head, 8-in. sand disc, sand drum, 2-in. jointer attachment, Boring table.

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Price \$13.50 for Woodturning
With Compound slide rest as illustrated, add \$10.50. Swing 7 inches. 17 inches between centers. Longer lengths 28 inches and 38 inches C to C. Bed heavy channel iron.



Universal Jig Saw \$12.00
Table 8 in. dia., tilts 45 degrees both ways. Saw to frame 10 in. Uses 1-16 in. fret blades, and heavy power blades 1-8 in. to 3-8 in. wide. Unexcelled in the volume and variety of work it will do.

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By our new plan we furnish complete outfit and give you a big assortment of giftwares free of extra charges. When you paint them as we show you they have a value of \$63.10. No extra cost for any of these things. This assures you a good profit and a big start without extra investment.

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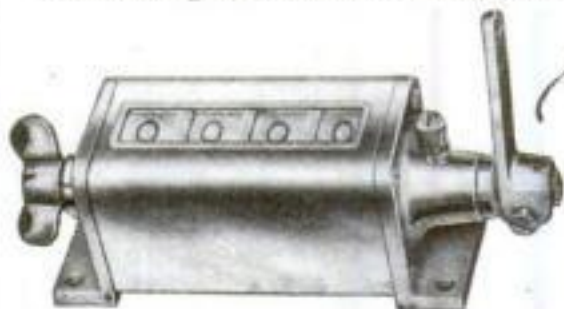
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Candlestick Turning

(Continued from page 112)

(Figs. 5 and 6) consists of two parts, the upright and the base. Let us turn the upright first. One end of it has a round tenon fitting into the base. The other end must be bored for the candle. Bore this hole with an auger bit before putting the stock in the lathe. As candle ends vary in diameter from $\frac{3}{4}$ to $\frac{7}{8}$ in., it is best to bore a hole $\frac{13}{16}$ in. in diameter and of about the same depth. A quick boring auger, that is, one with few threads on the spur, is the most satisfactory for end-wood boring.

Turn a plug or short cylinder to fit this hole accurately. It should be about $1\frac{1}{2}$ in. long, but in cutting it off be careful not to cut away the end with the hole made by the dead center. The plug should fit so that it can be forced with the hands into the hole in the candlestick. If too tight, it is likely to split the wood when it is



Fig. 3. Using the toe of a $\frac{1}{4}$ -in. skew chisel to bore the hole to take the tenon of the candlestick upright.



Fig. 4. Marking the diameter of the base with dividers held on the T-rest and centered by trial.

turned down to size; if too loose, it may have a piece of paper wrapped around it.

When the plug is placed in the hole, the end having the mark of the dead center should project so that it can run on the dead center of the lathe (Fig. 6). In this manner the hole bored for the candle will be accurately centered when the stock is turned. Turn the upright according to either of the designs given in Fig. 5.

Get out the stock for the base, plane it flat and true on one side, and cut the sharp corners off it. Screw a faceplate to the planed side of the piece, centering the plate as well as possible. The screws should be rather heavy, and their length depends upon where the screw holes in the faceplate are placed; there must be no danger of cutting into them.

If a small enough faceplate is not available, it will be necessary to use a screw chuck, which is merely a small faceplate with a screw in the center. In hardwoods small holes must be bored for the screws, and soap put on the threads of the screws will act as a lubricant and make it easier to drive them.

After the stock has been securely screwed to the faceplate, the live center is removed from

(Continued on page 116)

"Lava-clean" hands are clean!



Men—you who love to tinker—here's just the soap you need. Cleans quickly and thoroughly the toughest-looking pair of hands that ever fussed around a work bench. Makes more lather in 15 seconds than ordinary soap in 60, and even hard or cold water won't discourage it. Millions use it. "Good old Lava," they call it. Get hands clean! Not just "surface clean," but clean 'way down deep. As easy on your hands as fur-lined gloves—because it's made from the finest of vegetable oils. All grocers sell it.

Full size cake of Lava Soap FREE!

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Please send me, FREE, a full size cake of LAVA, the hand soap that removes all the dirt and grease.

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17-Jewel Elgin No. 15 Green gold, 23-year watch, 25-year quality case, 12 also, gift dial, \$30; \$330 a month down



Diamond Wedding Rings

In solid 18-k, white gold; 8 Diamonds, \$22.50; 6 Diamonds, \$32.50; 7 Diamonds, \$42.50; 9 Diamonds, \$52.50; 12 Diamonds, \$67.50. In solid platinum with 3 Diamonds, \$50; 6 Diamonds, \$70; 8 Diamonds, \$80; 9 Diamonds, \$100; surrounded by Diamonds, \$200.

No. 855 Ladies' Wrist Watch Solid 14-k white gold case, engraved, fancy wing ends, 15-Jewel movement, guaranteed, \$300 a month \$30. \$3.00 down

Our References: Any Bank or Banker in U.S.A.

Abox

DYNAMIC SPEAKERS



Wall Model



Console Model



Table Model



Model 66—A. C. Converter. Line voltage input—110-120 volts, 50-60 cycles A. C. Output—6 volts, 2 amperes D.C. Complete with receptacle for "B" unit and master control switch. Price \$35. (Higher on West Coast)

WHEN you first listen to an Abox Dynamic Speaker the improvement in tone quality is instantly recognized. The longer you listen to it, the more you appreciate the well-rounded tone, the life-like reproduction. Like those who are now enjoying Dynamic Speaker radio, you too will be well pleased with your investment. ABOX DYNAMIC SPEAKERS can be used on any set with a good audio system using a No. 112, No. 171, No. 210 or No. 250 tube in the output.

Three models are illustrated. The wall model introduces a new idea in Dynamic Speakers and is the best reproducer. The large front baffle-board and the walls of the room combine to approach the theoretically ideal baffle-board. The result is a speaker that produces better results than one mounted in a box type baffle-board.

Like all Abox Speaker cabinets, the wall model is beautifully finished and is a handsome ornament in any home. It takes up no floor or table space, which is an advantage in a well-filled room or small apartment.

Special care has been taken in the table and console models to produce not only beautiful furniture, but the best possible acoustical effects.

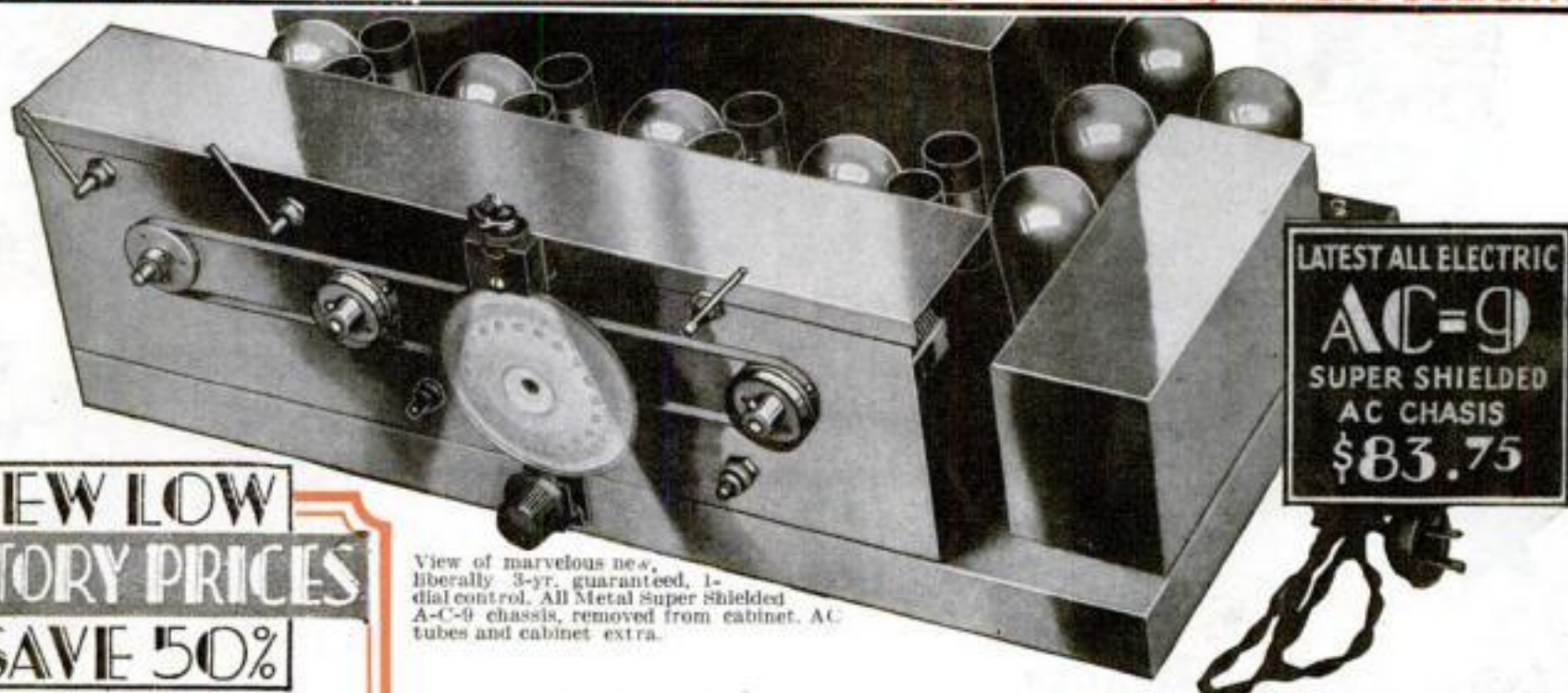
THE Abox A. C. Converter with any good "B" unit will make your set electric. The Abox changes 110 volts, 50-60 cycle current to 6 volt direct current to light the filaments of your standard tubes. No change in wiring, no change in tubes—simply discard the storage battery and the charger and attach Abox in a few minutes. Abox provides the convenience of true electric operation with a minimum investment. Send for free descriptive circulars.

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Rare bargain!

Richly designed,
genuine walnut con-
sole of finest type.
Electric dynamic or
magnetic power cone,
or long air column
speaker. Marvellous
value.



Beautifully graceful
spinet console, genu-
ine two-tone walnut.
Choice of speakers.
Also comes in Elec-
tric Phonograph-
Radio Combination.



A new-type arm-chair
console. Genuine wal-
nut. Very pretty. Low
priced. Power speakers.



At right, a Lo-
Boy console, wal-
nut finish, that costs
little. A gem!



Above, popular inexpen-
sive combination. Set on
table speaker (sold sepa-
rately).



Metal or wood com-
pact style cabi-
nets. Wood cabi-
nets in walnut or
new shaded silver-
chrome finishes.
Cathedral Electric
Dynamic or Mag-
netic Power Speak-
er to match!

View of marvelous new,
liberally 3-yr. guaranteed, 1-
dial control. All Metal Super Shielded
A-C-9 chassis, removed from cabinet. AC
tubes and cabinet extra.

MIRACO

TRADE MARK REGISTERED

CATHEDRAL TONED, SUPER SELECTIVE, POWERFUL DISTANCE GETTERS

Celebrating its 9th successful
year, America's big, old, reliable
Radio Corporation springs a
genuine sensation in high-grade
sets. With its latest, Super-

powered, 1-
dial Miraco's
—the All
Electric
wholly self-
contained, hum-
free, AC-8 and
AC-9, using AC
tubes or the new
7-tube models for
batteries or Eliminators—you are
guaranteed values and savings unsur-
passed in the fine set field.

Compare a Miraco with highest-priced
radios, for 30 days in your home. Sur-
prise and entertain your friends—get
their opinions. Unless 100% delighted,
don't buy it. Return everything—
the complete outfit—at our expense.
Your decision is final—absolutely!

Only exceptionally fine radios, of the
very latest approved type, at rock-bot-
tom prices, could possibly back up so
liberally unconditional a guarantee.
Send coupon now for Amazing Special
Factory Offer.

**Don't Confuse with
Cheap Radios**

With its rich, clear Cathedral tone,

amazingly hum-free operation, tre-
mendous "kick" on distant stations
and razor-edge selectivity—with its
costly sturdy construction, latest fea-
tures, including phonograph pick-up
connection, ease of tuning, beauty, and
economy—a Miraco will make you the
envy of many
whose radios cost
2 to 3 times as
much!

Many thousands
of Miracos—
bought after 30
days home com-
parisons—are
cutting through
locals and getting
distance with the tone and power of
costly sets, their delighted users
report. Miracos are laboratory-built
with finest parts, and embody 9 years'
actual experience in constructing fine
sets. Approved by Radio's highest
authorities.

**Deal Direct with
Big Factory**

Everything reaches you splendidly
packed and rigidly tested to insure
your instant enthusiasm. Enjoy the
outfit 30 days—then decide. Liberal
3-year guarantee on each set. Play
safe, save lots of money, and insure
satisfaction by dealing direct with
Radio's old, reliable builders of fine
sets—9th successful year.

**BIG DISCOUNTS
to User-Agents on
BATTERY OR AC
ELECTRIC OUTFITS**

IMPORTANT NOTICE!

"30 Day Free Trial" offers usually are money-back guarantees, frequently only on the "set." Please understand that unless you are thoroughly pleased we pay return charges and refund the FULL purchase price on both the "set" and ALL equipment—tubes, cabinet, speaker, antenna (also on batteries or eliminators with 7 tube sets). Could any offer be fairer?

Midwest Radio Corp'n, 408-AO Miraco Bldg., Cincinnati, Ohio

BEAUTIFULLY ILLUSTRATED CATALOG, AMAZING SPECIAL FACTORY OFFER, TESTIMONY OF NEARBY USERS—All the proof you want—of our honesty, fairness,

size, financial integrity, radio experience and the per-

formance of our sets—including Amazing Factory Offer—sent with catalog.

—————

MIDWEST RADIO CORPORATION,
Pioneer Builders of Sets—9th Successful Year
408-AO Miraco Bldg., Cincinnati, Ohio.

WITHOUT OBLIGATION, send free catalog, Amazing Special Factory Offer, testimony of nearby users, etc.
☐ User ☐ Agent ☐ Dealer

NAME

ADDRESS

**THIS COUPON
IS NOT
AN ORDER**



AC-8 \$71.50
for 3-year guaranteed Super
Shielded Metal Chassis
(similar to AC-9 shown
above).



**Also New, More Power-
ful Battery Sets**
The newest and latest in
battery operated sets, de-
signed with same advanced
features used in electric
sets! Same wide choice of
cabinets. Highest quality
amazingly low priced!

**7-Tube Battery
Super Shielded
Metal Chassis \$49.88**

Tubes, batteries or elimi-
nators and cabinets
are extra. 30 days home
trial on EVERYTHING!

**after 40 years
he ought to
know**



STAR HACK SAW BLADES

He ought to know....what Hack Saw Blades to buy.... mechanics of the old school that have spent a lifetime at their work will tell you that STAR HACK SAW BLADES are their choice.

Most of these old boys have tried them all and invariably you will find that today STAR BLADES are in their kit....they answer their daily needs for all kinds of cutting work.

After you have tried them, you too will find that they answer your needs.

Write for free samples.

Clemson Brothers, Inc.
Middletown, N. Y.

MAKERS SINCE 1883

STAR HACK SAWS



Makes Motor-Driven Sprayer for \$10



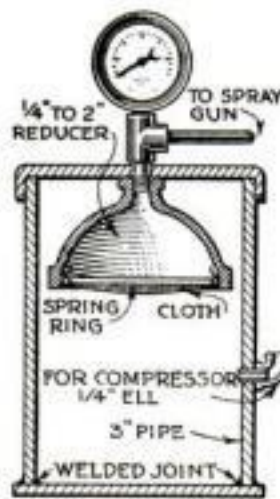
An old motor and a discarded compressor are the principal parts of this paint sprayer.

THE paint spraying outfit shown in the accompanying illustration cost less than \$10 to construct. With it I have done many lacquering jobs, including the finishing of a breakfast set.

The $\frac{1}{8}$ h.-p. motor is from a washing machine and cost \$5 secondhand; it serves for other purposes besides operating the spray. The compressor is a tire pump of the type many automobiles had geared to their pump shafts in years gone by. I bought it at a junk yard for \$1.

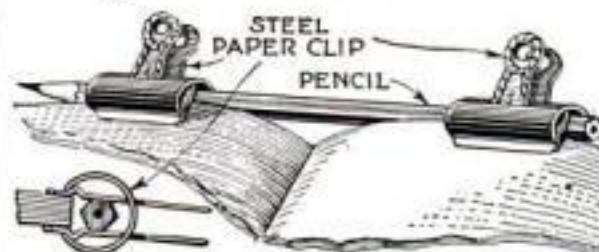
The tank is a waste piece of 3-in. pipe with a pipe cap screwed on one end and a base welded on the other. The pressure gage I purchased at a second-hand shop for \$1.50. The $\frac{1}{4}$ -in. pipe and fittings I had in my workshop as leftovers.

The method of installing the air filter in the tank is shown in the accompanying diagram. The spray gun is merely an old hand spray jet and a screw top jelly jar.—JOHN H. MOHR.



Section through the tank and air filter.

Paper Clips and Pencil Hold Open Reference Books



A simple method to use when referring to stiffly bound volumes and thick notebooks.

WHEN many notes have to be taken from a book which will not lie flat unless held down or weighted, the volume can be held open by the simple expedient illustrated. Two paper clips are fastened to the leaves on opposite sides and a pencil is run through them. This is particularly useful in a drafting room where designers and draftsmen frequently have to use reference books or field notes bound with fasteners.—E. M. QUIMBY.



Makes a perfect lasting patch

WHEN YOU fill a crack or hole with Rutland Patching Plaster, your wall is just as good as new. It makes a perfect patch that will last as long as the wall itself. It will not crack, crumble, shrink or fall out. Anyone can use Rutland Patching Plaster. You just mix with water and apply. No muss or bother.

Paint, wall paper and hardware stores sell it. If your dealer hasn't it we will mail a package direct and you can pay the postman 30c plus postage. Rutland Fire Clay Co., Dept. R-24 Rutland, Vermont. Also makers of Rutland Roof Coating.

A definite program for getting ahead financially will be found on page four of this issue.

Do Away with Handsanding



TAKE- ABOUT Sander

Large or small surfaces easily sanded with this little machine. Handles like a plane, leaving a flat even finish, due to the smooth action of belt. Sands five times faster than by hand. Fine for refinishing furniture, woodwork, stairs, floors etc. Works from any light socket. No experience required to operate.

PORTER-CABLE MACHINE CO.
2000 Salina St. Syracuse, N. Y.

pin this ad to your inquiry

Be There
with BT

Bremer-Tully Radio

"The Finest We
Ever Heard"

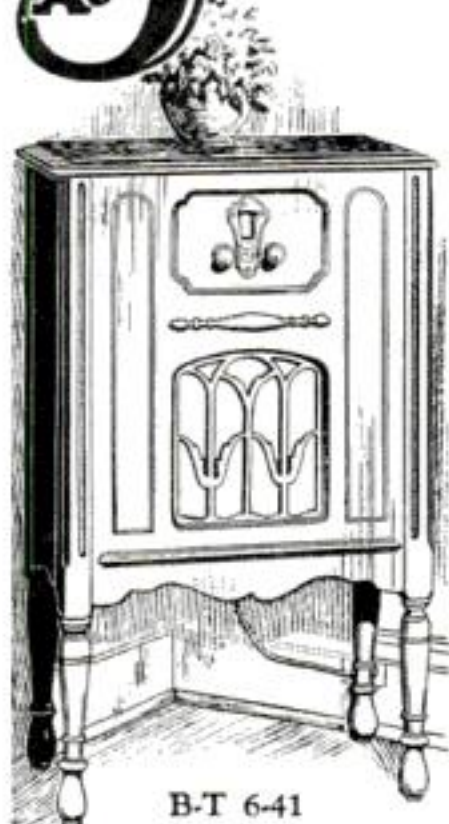
—the verdict of those who
appreciate the best

THE Bremer-Tully record for *highest quality* is well-known to every radio enthusiast—and *even that has been exceeded* in these latest B-T models.

Backed by seven years intensive manufacturing experience they offer you your safest radio investment.

Every B-T product is *Quality* throughout. Not a single item was ever built to sell on price—yet you will find that Bremer-Tully Quality costs less in the end—and brings you much greater satisfaction meanwhile.

Furthermore, you will find that Bremer-Tully radio is handled by the best merchants—Those who sell quality only.



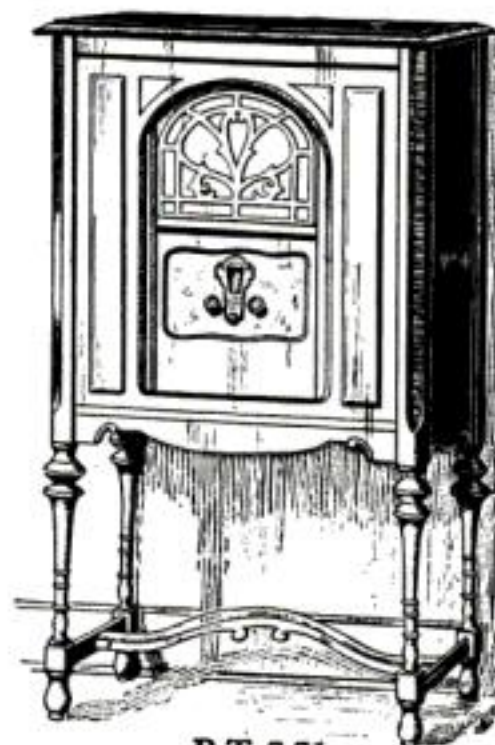
B-T 6-41

Six tubes and rectifier, A. C. only, single control, dynamic drive. An exclusive feature—the Antenna Compensator provides far greater sensitivity than would be possible otherwise. American walnut cabinet. Price, less tubes \$190.00.

At top of page

B-T 8-21

Chassis same as B-T 8-21. Beautiful burl walnut cabinet, dynamic speaker. Price, less tubes, \$375.00.



B-T 7-71

Seven tubes and rectifier, A. C. only, single control, push-pull power audio, dynamic drive. A brand new B-T feature provides for choosing tone characteristics as preferred and insures pleasing reception at many times when static ruins ordinary set performance.

American walnut cabinet with decorative maple overlays, sliding doors. Price, with built-in Dynamic Speaker, less tubes, \$280.00.

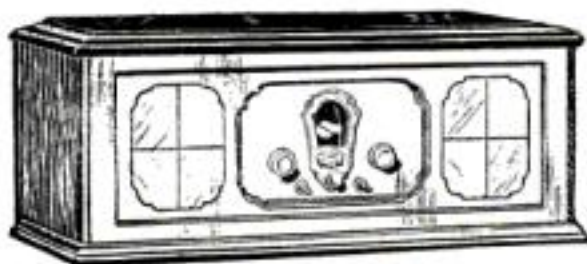
Send coupon for details

Bremer-Tully Mfg. Company

656-662 Washington Blvd.

Chicago

Are you interested in Television? We are at work. Send the coupon and we will advise you as soon as there is anything definite.



B-T 8-20

Eight tubes and rectifier, A. C. only, single control, B.-T. rejector and other exclusive features. Walnut cabinet. Price, less tubes, \$230.00.

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☐ Dynamic Speakers
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PS-10



The finest money can buy

Just think how much you use a hammer. Are you content to get along with any but the best?

The head of every Maydole Hammer is of press-forged tool steel, beautifully tempered. The handle is of clear, second-growth hickory, air-dried for years and put on "for keeps."

Ask your tool dealer to show you Maydoles. He has a complete range of styles and weights. See for yourself what really fine tools they are. You'll enjoy using them and they're good for a lifetime of hard service. Insist on the genuine Maydole—the name is stamped on the head.



The Norwich Ball Pein Hammer

A drop-forged Ball Pein Hammer with a beautiful "hang" at a price that makes it a wonderful value. An ideal extra hammer for home, shop, garage or farm. Ask your dealer to show you the Norwich Hammer.

YOUR HAMMER SINCE 1843
Maydole
Hammers

The David Maydole Hammer Co., Norwich, N.Y.
1844

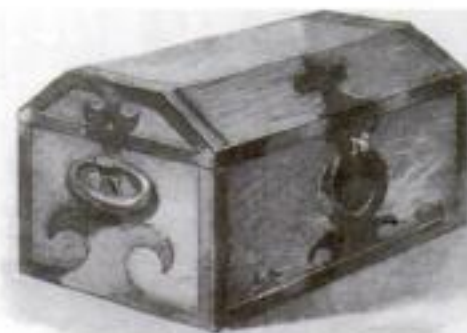
This Radio Cabinet Looks Like a Pirate's Chest

By FLOYD E. FREEMAN

ANCIENT looking treasure or pirate chests, which have become so popular for purely decorative purposes, make a novel and excellent type of cabinet for sheltering homemade radio sets. They are of distinctive appearance and allow unusual ease of access to the set itself, especially if built according to some such plan as that illustrated below.

A chest of this sort may be made of walnut, mahogany, oak, or a more easily worked wood. The construction is comparatively simple.

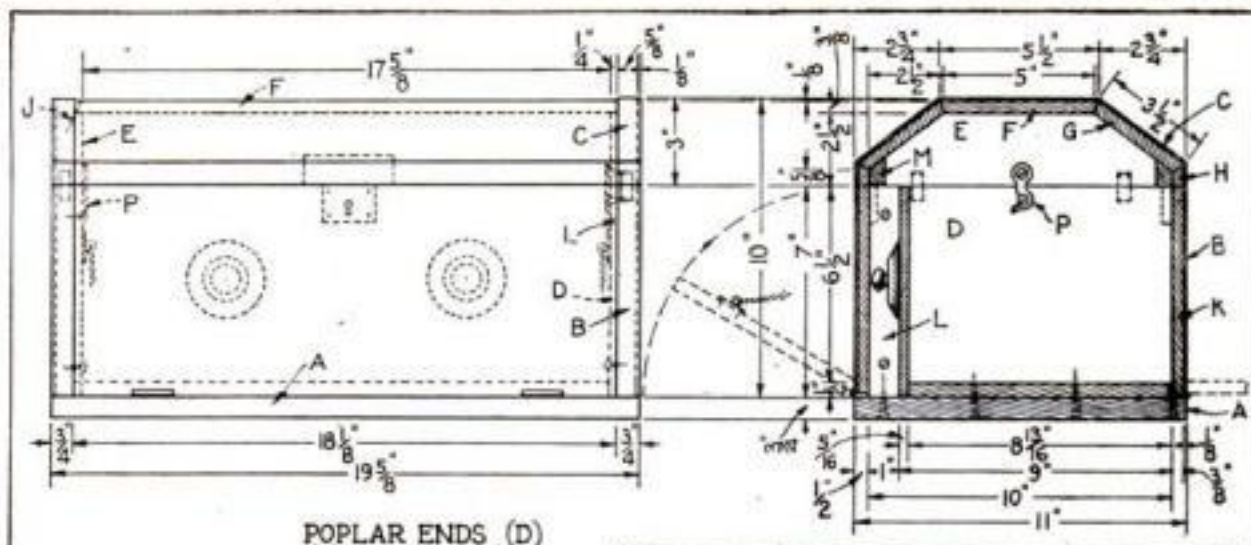
Make the bottom A $\frac{3}{4}$ by 11 by $19\frac{5}{8}$ in. and the two chest ends B $\frac{5}{8}$ by 7 by 11 in. Smooth, sandpaper, and fasten them in place with four $1\frac{1}{2}$ -in. No. 8 screws through the bottom. The two chest cover ends C , $\frac{5}{8}$ by 3 by 11 in., should be shaped, fitted, and doweled to the top ends of B as indicated. The poplar or whitewood inner ends D , $\frac{1}{4}$ by $6\frac{1}{2}$ by $8\frac{1}{2}$ in. and E , $\frac{1}{4}$ by $2\frac{1}{2}$ by 10 in., should be shaped and fastened in place with glue and $\frac{3}{4}$ -in. No. 17 brads. Cover piece F , $\frac{3}{8}$ by $5\frac{1}{2}$ by $18\frac{1}{8}$ in., two pieces G , $\frac{3}{8}$ by $3\frac{1}{2}$ by $18\frac{1}{8}$ in., and two pieces H , $\frac{3}{8}$ by $\frac{7}{8}$ by



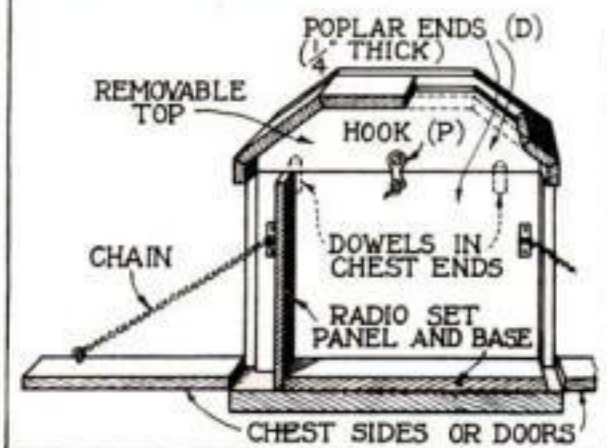
The treasure chest when closed is a handsome ornament for a living-room table.

any set with a 7 by 18 in. panel and not more than 10 in. deep over all. The base can slide under the inner ends D , which may be cut to receive it, or the bottom of the chest may be used as the bottom of the set. Pieces L , $\frac{1}{4}$ by 1 by 7 in., may be fitted after the set is in place and fastened with $\frac{5}{8}$ -in. No. 6 round-head screws. These pieces hold the set in place and act as door stops.

Fit small locks on the doors. Place



Front view and cross section of the radio cabinet with dimensions, and a diagram to show some points of the construction.



$18\frac{1}{8}$ in., should be fitted with correctly beveled edges, smoothed, sandpapered, and glued in place. If 1-in. No. 18 brads can be driven skillfully in place and set below the surface as at J , they will strengthen the cover. The two doors, flaps, or chest sides K , $\frac{3}{8}$ by 7 by $18\frac{1}{8}$ in., should be made of quarter-sawn pieces to prevent warping. They are fitted and hung with 1-in. narrow brass butts and supported by narrow brass chains with eye plates, or with desk slides or stays.

A chest of these dimensions will receive

hooks at P inside the ends to hold the cover and permit its easy removal for access to the set. Pieces M , $\frac{1}{2}$ by 1 by 3 in., may be fitted and glued in place to receive the bolt of each lock.

Make the decorative straps and designs from $\frac{1}{8}$ -in. veneer and glue them in place as indicated; this will make the edges of the ends $\frac{3}{4}$ in. thick. The handles and supports may be worked to shape from $\frac{1}{2}$ -in. wood and glued in place.

Aerial and ground connections are made by means of two midget jacks and plugs fastened to a small piece of panel, which is fitted into the base at one end of the cabinet and fastened with screws.

The chest may be finished with stain, shellac, and rubbing varnish. The straps and other decorations may be given two coats of brown lacquer or finished with aluminum, copper, or bronze paint, or with black shellac rubbed to a dead finish.

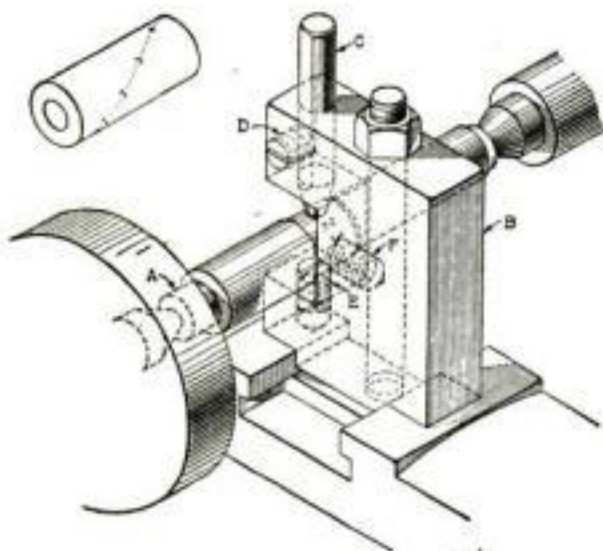
How to Letter and Number Small Round Parts

By Henry Simon

ANYONE who has ever attempted to letter small cylindrical work neatly, knows that it is difficult. Otherwise well-made parts are often deficient in this one respect. As a very slight displacement of a single letter is enough to spoil the appearance of a piece, the chances are all against the man who tries to do such work by ordinary means.

With the simple arrangement illustrated, the job is done easily in a fraction of the time otherwise required. With the tool once on hand, various sizes and kinds of such work can be handled, and duplicate pieces, in particular, are finished rapidly and uniformly. The tool is not confined to lettering; longitudinal and radial divisions on the cylindrical body as well as center-punch marks may be made readily and accurately.

The tool is used in connection with a lathe, on which in this instance the work



A simple fixture for lettering, numbering or marking divisions on cylindrical work.

is held between centers on an arbor, A. The tool itself consists of a square block of cold rolled steel, B, held in place on the compound rest by a clamp bolt, the foot of the block being let into the T-slot to insure its accurate location. A large notch in the front of the block makes room for the work. Round-shank punches like C, flat on one side, are used. They are held by slight friction and prevented from turning by a screw, D. In order to absorb the strain caused by the hammer blow and prevent it from falling upon the centers, a support screw, E, is provided in the bottom prong of the notch. A third screw, F, let into the rear wall of the notch, serves to center the block on the article.

The only item of any expense is the special set of round stamps. If no such set exists in the shop, a die sinker will cut a set of average-sized figures for about ten dollars, and as such stamps can be used on other work and will outlast ordinary cheap letters, this is reasonable enough. A center punch of the same size shank as the letters should be made at the same time.

Care must be (Continued on page 122)

"...and Your Satisfaction"

"Yankee" No. 10
Ratchet Screw-driver. Just turn to and fro, and in goes the screw. Right and Left Ratchet; and Rigid. Eight blade lengths, 2 to 12 inches. Prices, 65c, 80c, 85c up.

"Yankee" No. 15
Ratchet Screw-driver, with thumb-turn for starting wobbly screws. Right and Left Ratchet; and Rigid. Blade $\frac{3}{16}$ " diameter; six lengths: 2 to 8 inches. Prices, 70c, 75c, 80c up.

"Yankee" No. 41
Automatic Push Drill, with 8 Drill Points $\frac{1}{16}$ " to $\frac{1}{4}$ ", in handle. Bore holes by pushing on handle. Price, \$2.60.

"Yankee" World-famous Spiral Driver
No. 30-A.—Standard Pattern. Price, \$3.00
No. 31-A.—Heavy, \$4.00
No. 35.—Light, \$2.25.

Spring in handle makes it the "Quick Return".
No. 130-A. \$3.45.
No. 131-A. \$4.60.
No. 135.—Light, \$2.65.
Three blades with each tool.

"YANKEE" TOOL BOOK, filled with action pictures of ingenious tools, of special interest to readers of Popular Science Monthly, sent free on request.

You know,—

when your hardware dealer offers you "Yankee" Tools, that he values his own reputation—and your satisfaction.

There is no substitute for "Yankee." There never can be! For "Yankee" knows only one standard. It never will know any other. That standard is:

"YANKEE" on the tool you buy means the utmost in quality, efficiency, and durability. Not merely good—the utmost!

NORTH BROS. MFG. CO., Philadelphia, U. S. A.

"YANKEE" TOOLS

Make Better Mechanics

New Plans

		Model Size	Over All Period
Isaac Webb	185-ft. Packet Ship	18 inches	1850
Rainbow	159-ft. Clipper Ship	19 inches	1841
Helena	135-ft. Clipper Ship	18 inches	1841

Naval Vessels

Alfred	24-Gun Ship (First American Flagship)	15 inches	1775
Ohio	74-Gun	20 inches	1810
Monitor	Single Turret Ship	22 inches	1861
Merrimac	Iron Clad Steamer	33 inches	1861
Oregon	Battleship	41 inches	1890
Battle Cruiser	Typical	26 inches	Mod.

Merchant and Historic Vessels

Flying Cloud	125-ft. Clipper Ship	18 inches	1851
Smuggler	Gloucester Schooner	10 inches	1877
America	Schooner Yacht	15 inches	1851
Half Moon	Hendrick Hudson's Ship	19 inches	1609

And there are dozens of others
listed in the Catalog

for Model Makers

THE plans for the ship models listed above are the result of years of personal effort and study of Marine Models. For 23 years, since 1905, Boucher has conducted a Model Shop where practically all the Marine Models made in the United States have been turned out.

You can buy the model plans of the ships listed above and be sure they are as clear, thorough and accurate as possible. Let us know the plan or plans you are interested in and we will send you full information. Also it will pay you many times over to have the encyclopedic-catalog "Scale Models."

Complete materials for building decorative ship models of all types . . . naval vessels . . . model power boats . . . model sailing yachts.



The famous Boucher Booklet of Scale Models is a veritable treasure house of information and practical help for men and boys who are interested in ship models.

Anchors, blocks, cleats, steering wheels, chocks, davits, running lights and all the other equipment for building decorative models are listed and illustrated in the booklet, SCALE MODELS. All Boucher equipment is accurately made to size and beautifully finished.

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This booklet—SCALE MODELS—has 89 pages of useful information for model makers. Contains history of steam engines, nautical terms, knots, hitches and splices commonly used on boats. Recommendations for finishing and painting model ships and hundreds of other ideas you will find useful.



Whatever type of ship—sail or steam—ancient or modern—you are building, or planning to build, you will find the booklet, SCALE MODELS, of tremendous help. Send 25c today for your beautifully illustrated copy. It will be sent you by return mail, postage prepaid.

Gentlemen:—Enclosed is 25c for which please send me immediately your 92-page illustrated booklet, SCALE MODELS.

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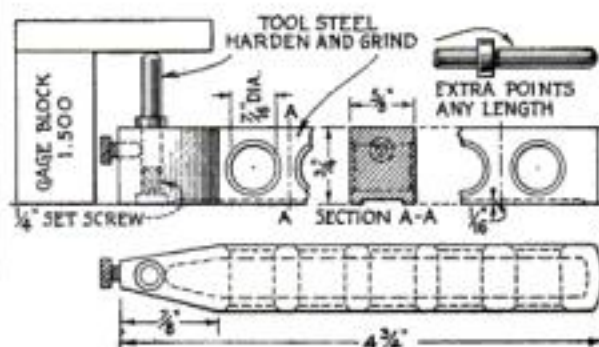
Headquarters for Model Makers for 23 Years

Boucher Inc
415 Madison Ave. Dept. MA N.Y.

How to Extend the Life of Costly Gage Blocks

PRECISION gage blocks can be saved from wear and their accuracy preserved for a longer time if they are supplemented by a gage of the type illustrated. It is a compact and convenient auxiliary to a set of costly gage blocks, and the toolmaker will find many uses for it.

The bar is made of tool steel and ground all over. As an extra touch of refinement,



Side and top views of the auxiliary gage and how it is set with toolmakers' gage blocks.

the bottom surface may be lapped. The bar is drilled to reduce the weight and the surface contact is reduced by undercutting the bottom surface about $\frac{1}{16}$ in. A set of interchangeable points are made, ranging by $\frac{1}{2}$ -in. steps to any length desired. A set screw provides the means for adjusting the point up or down as may be necessary.—H. L. W.

Hints on Babbitting Boxes

OIL holes into babbitted boxes can be provided without drilling if tapered wooden plugs are inserted before the babbitt is poured. The plug should have a flat end and be in contact with the babbitting mandrel. Where the boxes are solid, common yellow laundry soap can be rubbed on the shaft before the babbitt is poured. This will make enough clearance in itself to insure a good running fit.—HAWLEY L. SCOTT.

Lettering Round Parts

(Continued from page 121)

exercised to get the flat on the shanks even and perpendicular to center line of the figure. Some kind of a division should be made upon the edge of the large pulley on the step cone so that the spindle can be turned the required distance for each successive letter or figure. In this way, letters can be spaced longitudinally and radially and also in any desired spiral arrangement, as shown in the small diagram.

In applying the tool, the support screw E is set about .002 in. low so that, while it does not touch the part, it will yet take practically all of the strain. With the center punch in place, screw F is adjusted until the distance from its face to the point of the punch is exactly one half of the diameter to be stamped.

THE ENDS OF discarded hack saw blades make good fingers for sharpening cutters, reamers, and the like.—H. V. C.



Giant Chest Expander and Progressive Exerciser

Be a muscular marvel. Have the muscles of a superman. Become strong for your health's sake or to astound your friends with extraordinary feats which only men of giant strength can do. In a few short weeks you will easily do stunts which now seem difficult—then real muscles and strength will be yours—and yours to keep. If you want exercise to just keep in good shape you can reduce the strength of the Progressive Exerciser by substituting as many cables as you wish. If you want great resistance as an aid to build up big solid muscles, then use the full strength.

HOW IT IS MADE
Made of new, live, springy rubber so as to give it long wearing and great resisting qualities. Do not pay more for an exerciser that has forty or less rubber strands to each cable. Get the best and most durable. The Giant Progressive Exerciser has 60 strands of the finest rubber procurable to each cable.

FREE INSTRUCTIONS
We do not think it enough to send you an exerciser worth double what we ask, and for a limited time, we will also include instructions absolutely free. These instructions are interesting and simple to follow.

YOUR GUARANTEE
The Giant Chest Expander is sold with a guarantee that you will say it is the finest you ever saw or your money back.

\$2 FOR 5 CABLES
\$4 FOR 10 CABLES
\$6 FOR 15 CABLES
\$8 FOR 20 CABLES

HOW TO ORDER—SEND NO MONEY
Sign your name and address to coupon below and get your Giant Exerciser by return mail. The price is made low because we want everyone to enjoy muscles and strength at the lowest possible cost. Don't pay more—order from us—get the most for your money. Use coupon now.

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6010 Langdon Bldg.,
Broadway and Duane Street, New York.

Please send ☐ Your 10 cable ☐ Your 15 Cable ☐ Progressive Exerciser
☐ Your 5 cable ☐ Your 20 Cable ☐ Exerciser
Check the Exerciser you want. It will be sent by return mail. Pay postman introductory price, plus few cents postage on arrival. If you are not entirely satisfied with your exerciser you may return it within 5 days and get your money back.

Name.....
Street.....
City..... State.....
If you live outside the United States send cash with order.

only \$1.00 DOWN

10 Day FREE Trial

You can have a genuine L. C. Smith (the world's only ball bearing typewriter) for \$1 down. Lowest price ever offered! Easiest terms. All the 1928 operating attachments. Re-noved. GUARANTEED FOR 6 YEARS. \$1 down and we ship. No delay. No red tape. 10 day Free Trial. Free Typewriter Course. Tools. Waterproof Cover if you act now. Write for \$1 down offer and free manual. **SMITH TYPEWRITER SALES CORP.**
53-A - 360 E. Grand Ave. Chicago, Ill.

OTTAWA LOG SAW
only \$39

GREATEST OFFER EVER MADE

Make Money! Wood is valuable. Saw 15 to 20 cords a day. Does more than 10 men. Ottawa easily operated by man or boy. Pile trees—saws limbs. Use 4-hp. engine for other work. **30 DAYS TRIAL.** Write today for FREE book. Shipped from factory or nearest of 10 branch houses.

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WITH OUR HELP

Turn idle hours into welcome dollars building clocks, very profitable spare time work. We furnish plans, instructions, works, dials and all materials at low prices.

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Works As Low As \$1.65
Grandfather Clocks with Chimes
Write for Catalog and FREE Blueprint Plan.

American Chime Clock Co. 1691-M Ruffner Street Philadelphia, Pa.

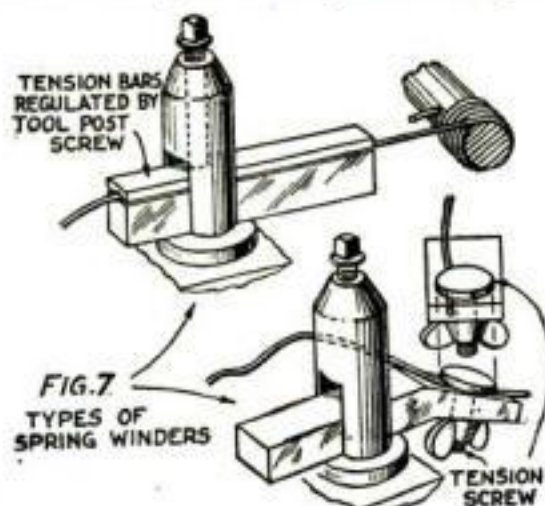
Winding Springs Is Easy

(Continued from page 84)

and found the gearing correct for four coils an inch. He started the first spring and then turned the job over to Jack. He stood by and watched him make two springs and then left, satisfied that the young man could get along without further coaching.

Another way to handle music wire, it should be added, is to place the coils between two short pieces of board in a bench vise. Cut the binders as you rotate the coil between the vise jaws; but before cutting the last binder, tighten the vise. When all four are cut, release the pressure slightly while holding the wire down with one hand. Cautiously allow it to expand, and then tie it in two places as before.

Jack found that there was considerable spring making to be done in connection with the miscellaneous odd jobs which passed through the



Simple shopmade tools for winding springs. A third type is illustrated in Fig. 6 on page 84.

shop in unending variety. He learned much from Wilkins and by observing the other machinists.

He soon found, for instance, that spring making as done in the small shop is altogether different from the manufacturing of springs as a business in itself. The manufacturer has special tools, automatic machinery, and scientific methods for controlling material specifications and spring temper. The average mechanic does not need to concern himself with such matters, but must know how to make springs in small quantities when necessary.

Springs of both the compression and the expansion type are wound cold over a mandrel. A mandrel less than $\frac{3}{8}$ in. in diameter should be driven by means of a drill chuck fitted to the lathe spindle. Those of a larger diameter are driven with the lathe chuck or by means of a dog.

THE most convenient method of starting the wire is through a hole drilled in the arbor as shown in Fig. 2. Some mechanics, however, prefer to use a plain arbor and pinch the end of the wire under one of the chuck jaws.

Some experimenting is often necessary in order to obtain the correct outside spring diameter. This, Jack found, might be because the arbor was too large or too small, or because the tension on the wire was not just right. Indeed, it is not such a simple trick as it may seem to produce a number of springs having the same characteristics and with a minimum variation.

To make a spring from solid bar stock, similar to the one shown in Fig. 3, the method which Jack learned was to cut off a piece of stock slightly larger in diameter than the spring and bore a hole through it corresponding to the inside diameter of the spring.

The next operation was to cut the spiral, which was done on an arbor. The tool had to be the width of a corresponding thread tool. The cut was run in to within a few thousandths of the inside diameter, just enough stock being left to hold the spring (Continued on page 124)

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Winding Springs Is Easy

(Continued from page 123)

together while it was being pressed off the arbor. The thin wall was then punched out with a blunt chisel or drift, and the sharp edges were removed inside and out with a file before the spring was hardened and tempered.

Springs of this type usually are made with a square or rectangular cross section, and the method of cutting the spiral is much the same as in cutting a square thread.

A conical shaped spring, like that in Fig. 4, is made on a taper arbor as shown in Fig. 5. The arbor has a taper shank that fits the lathe spindle, and it is provided with a half-round groove cut to the pitch of the spring. The depth of the groove should be one half the diameter of the wire. A hole is drilled at the beginning of the groove to serve as a starting point for the wire.

In Fig. 6 is illustrated an inexpensive bench fixture that can be used for making small springs by hand. It is surprisingly speedy when used in conjunction with the simple wire tool shown. This tool is merely a piece of flat cold-rolled steel with a hole near one end, through which the wire passes. The pitch of the coil is governed automatically.

In the course of his shop experience, Jack found that many different types of commercial spring winding tools are available, but he also saw equally good work done with inexpensive tools of the kinds illustrated in Figs. 6 and 7.

PERHAPS machinists do not always realize the importance of the material itself in the operation and life of a spring. It is far from easy to control variation, and this accounts for the fact that springs subjected to heavy duty will frequently fail in spite of the fact that similar springs made in exactly the same way give good service.

The great advantage in using music wire lies in the fact that it is tempered. Springs made of it need no further treatment. It is a high grade material and generally produces uniform results if the springs are correctly made for the work they are to do.

Music wire sizes range from .004 to .146 in., and it can be had in even larger sizes up to $\frac{3}{16}$ in. Springs of heavier wire are usually made to the steel wire (Washburn and Moen) gage, which has a range of 57 sizes from .0044 to .490 in.

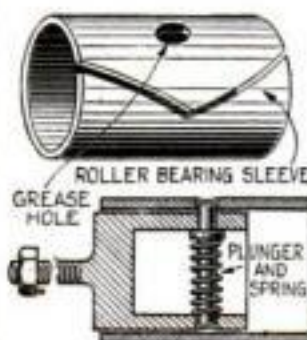
Some of the large size spring wire is known as oil tempered and requires no further heat treatment. Music wire is cold drawn to give the desired temper and has a carbon content of .85. A cheaper cold drawn spring wire, which is frequently used, has a carbon content of .65. Annealed steel wire is also used and heat-treated after the springs have been made.

Phosphor bronze wire is cold drawn to temper it and contains 8 percent tin. Nickel silver wire is rolled or drawn to temper and contains 55 percent copper, 18 percent nickel and 26 percent zinc. Monel metal wire also is rolled or drawn to temper.

Any machinist who will remember these facts will find it easy to work out any ordinary problem connected with making springs.

Pulling Bearing Sleeves

IN THE sleeve puller illustrated, a plunger engages the grease hole in split sleeves of a type commonly used with certain roller bearings. The plunger has a collar for the spring to push against. A pull rod is provided for use with a crossbar of some kind, which rests against the housing.—G. A. L.



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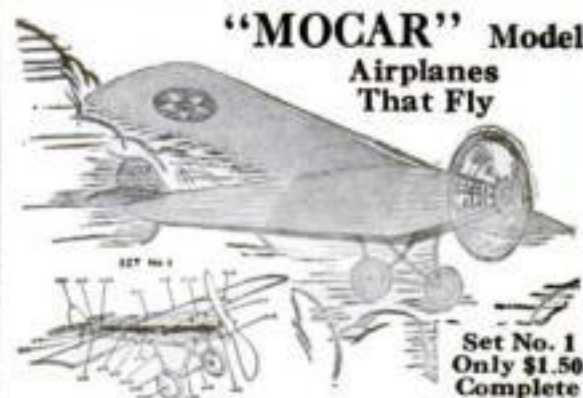
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Shop Short Cuts

(Continued from page 86)

clears the wheel. Move the table in half the linear pitch (not lead) of the worm. Then index the wheel around just half a tooth.

Start the machine and raise the wheel into the cutter, stopping the feed at the same place on "O" as when gashing. Go around all the teeth in this way, taking a little stock off the side; then set the machine for the other side of the teeth and go around again. This will make the tooth points thin enough for the hob to start. Figure on .010 in. for the hob to remove.—FRED S. SAUNDERS.

WHEN it is necessary to cut a groove in a shaft with an end mill held in the vertical attachment of a milling machine, considerable time is sometimes consumed in setting the cutter central with the shaft. The following method, which is sufficiently accurate for all ordinary purposes, may be of interest.

With the shaft clamped on the milling machine table, run the end mill across it to produce a flat surface. Increase the depth of the cut until the width of this flat just equals or is slightly wider than the width of the groove to be cut. Then set the end mill so that its edges are central with the edges of the flat spot on the shaft, when it will be ready for cutting the groove. A check-up by actual measurements will show that the work can be positioned with surprising accuracy by this method.—R. H. KASPER.

Odd-Job Tips for Handy Men

(Continued from page 80)

firmly in place, it is difficult, if not impossible, to remove it without damaging it to such an extent that a new pipe is required.—W. C. C.

AMONG the many purposes to which an old baby carriage wheel may be adapted is to form a clothes hanger (Fig. 5, lower view) in mother's or sister's room. Clean the wheel thoroughly, give it a coat of metallic paint, brushing lacquer, or enamel colors, and mount it beneath a shelf with a $\frac{3}{8}$ -in. carriage bolt, nut, and washer. The wheel must be placed so that it will revolve freely when supporting the coat or dress hangers. The hangers are not hooked directly over the rim but are hung on S-shaped hooks of brass or copper wire. The hangers adapt themselves to each other as the wheel is turned.

In a similar way a large rear wheel from a perambulator and a smaller front wheel can be mounted on a pedestal like that shown in the upper view of Fig. 5 to form a costumer. After decorating the wheels with silver or bronze paint, make the wooden upright and paint it with brushing lacquer. Then mount the wheel by means of a lag screw or iron rod so that it will turn easily but without wobbling. Fasten to the wheels a number of hooks bent from soft brass or copper wire, or adapt picture hooks to the same purpose.—CHARLES A. KING.

MANY fireplaces that smoke up the rooms in which they are placed, and some that draw well enough but give no heat, can be remedied by laying a new floor of fire brick in order to bring the height of the opening in proper proportion to the width. In some instances, however, the correction must be made by building out the back wall with fire brick. When it is necessary to place fire brick, the proper cement or mortar is a mixture of fire clay and water. This kind of mortar is also used for setting fire brick linings in furnaces, stove water-tank heaters, and other places that are subjected to high temperatures. Fire clay may be purchased from building material supply houses and from some hardware stores.—F. N. V.

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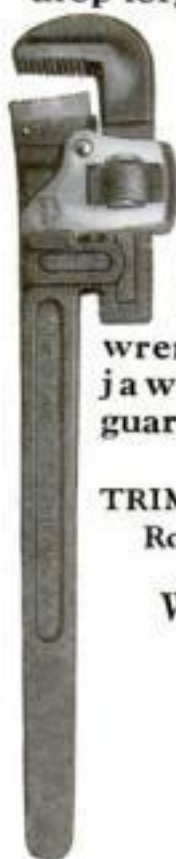
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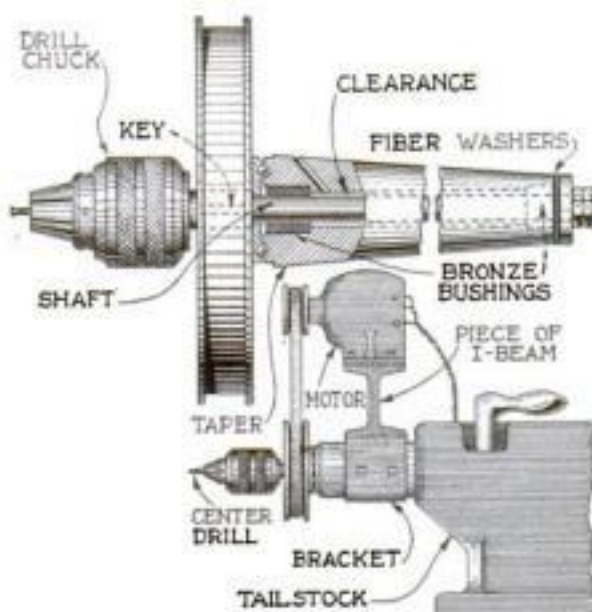
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Tailstock Centering Attachment for Large Lathe

THREE hundred forged nickel-steel shafts, $2\frac{1}{2}$ in. in diameter and 5 ft. long, had to be cut to length, faced and centered, preparatory to a turning operation which required first-class workmanship and high production. The only machine available that would take them through the spindle was an old 24-in. low-speed, heavy-duty lathe. The gang boss had rigged up universal chucks on the faceplate and rear end of the live spindle to prevent chatter and center shafts without much truing up, and was using a drill chuck in the tailstock to hold the center drill.

With the slow speed of the center drill and the desire of the apprentice operator to feed the drill fast, a number of drills were broken. It was decided that more speed was needed at the center drill, so



The high speed centering attachment and the way to mount it on a heavy-duty lathe.

the supervisor was instructed to make up the fixture illustrated.

A bracket was made to fit over the tailstock spindle out of a scrap piece of iron and a short length of 8-in. I-beam. A $\frac{1}{4}$ -h.p. motor was fastened to the top.

A modified center was made of machine steel as shown. A ball race was cut in it and it was casehardened and bushed at both ends with brass.

The shaft was of carbon steel, hardened and ground on the bearing surfaces, but I believe that plain shaft would have answered. The other half of the ball race was pushed on the shaft against the shoulder, a keyway for the driven pulley was cut, and a commercial drill chuck fitted.

Speed reduction from the motor was about $3\frac{1}{2}$ to 1; with work running at 100 r.p.m., production was excellent and there was no drill breakage.

The operation was as follows: Shafts, previously marked for length with punch, were centered in the lathe in the universal chucks, surplus metal was removed with a cutting-off tool; a facing tool on back of the carriage was used, tailstock brought up and the shaft centered.—W. C. C.



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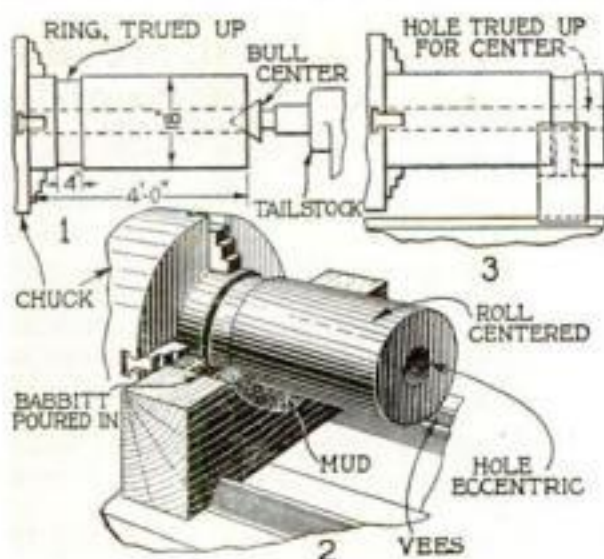
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Wood and Babbitt Used to Make Steady Rest

SOME unusual problems were presented in the machining of a cast-iron roll forming part of a special machine, and the ingenious methods applied by the machinist may be of interest and help to other mechanics.

When delivered to the machine shop, the casting for the roll was found to have very little stock for finishing, and the hole was not true with the outside. Furthermore, the shop did not have a steady rest large enough to take the roll. This led to the use of the babbitt-lined



An awkward casting was supported with an improvised steady rest lined with babbitt.

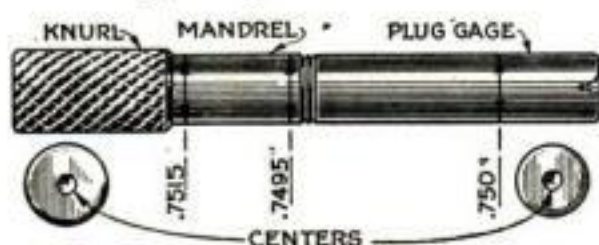
steady rest shown in Figs. 2 and 3 of the accompanying illustration.

The first operation on the roll was to swing it in the lathe with one end chucked and the other on a bull center. The chuck end was trued up by the outside, while the tailstock end was trued up a little by chipping the center. However, this was not especially important.

A ring about 4 in. long and close to the chuck was turned true at this setting. Without moving the roll, a wooden block, which had been sawed on the bottom to fit the lathe vees and cut out semicircularly on the top, was placed under the roll as shown in Fig. 2. A mud dam was made, and babbitt poured into the space.

This made a steady rest for the second operation, which consisted of boring the hole at one end a press fit for the shaft, and rough turning the outside. The casting was then reversed for boring the other end, using the same steady rest. The shafts were pressed in the ends, and the roll finished on its own centers.

Plug Gage and Arbor



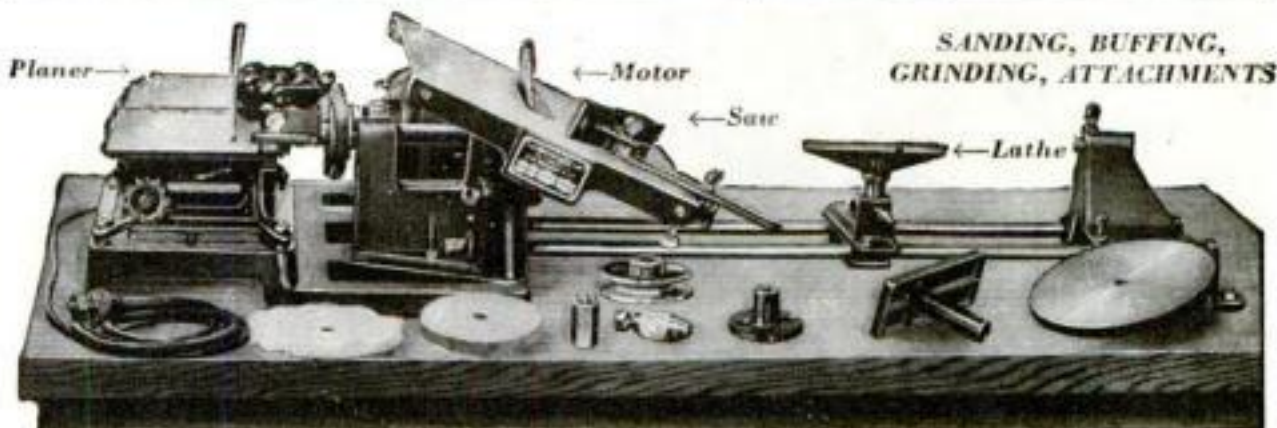
A mandrel and gage for making bushings.

IN MAKING bushings for drill jigs or similar work, the combined plug gage and arbor illustrated will save much time. It should be made of tool steel, hardened, or of machine steel, pack hardened.—H. J. C.

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How to Clean Paint and Lacquer Brushes

LACQUER brushes should be wiped out as dry as possible after use, then shaped up and allowed to dry. When ready to use them again, soak them in lacquer thinner. If one brush is to be used in several colors, it must be thoroughly cleaned when colors are changed. Dip the brush in thinner, filling it quite full. Pour some kitchen washing powder in a cup, say one-fourth full, and stir it with the lacquer brush until the hairs stand out separately. See that the powder is well down among the hairs and that no wet lacquer remains. Work the brush in the powder a few minutes more; then wash it in clean water. The powder coagulates the lacquer, which can be easily washed off in fine particles. Dry the brush on a cloth, rinse in a little thinner, and you are ready to dip it into a new color. This method is much more economical than washing brushes in thinner alone.

With ordinary paint brushes, the first precaution is not to let the paint dry on the brush. Keep an old catalog or magazine handy and, just as soon as the painting job is finished, wrap the brush tightly in the paper. Fold the end over at the tips of the bristles. This keeps the bristles straight and preserves the chisel point.

On a handy shelf, keep a can with the top cut out and containing enough kerosene in it to come well over the ferrule of the brushes. Always store the wrapped paint brushes in this can. It is best to hang them on a wire placed across the top of the can so that they will not touch the bottom. The kerosene keeps the bristles soft, while the paper keeps the brush in good trim and does not allow the kerosene to become fouled.

To clean a brush before using it, squeeze out the kerosene and pour gasoline down the up-turned bristles. Then shoot a strong stream of water on it from the garden hose. Rinse it finally in clean gasoline and swish out the surplus on the edge of a board. In this way the writer has kept brushes in perfect shape for two years.—**GRAHAM STUCKEY.**

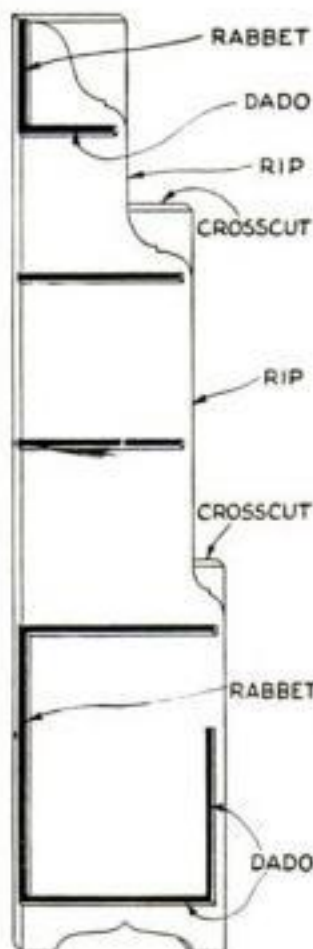
Easy-to-Build Bookcase

(Continued from page 90)

making of rabbets and dados, although it will not be quite as strong and workmanlike.

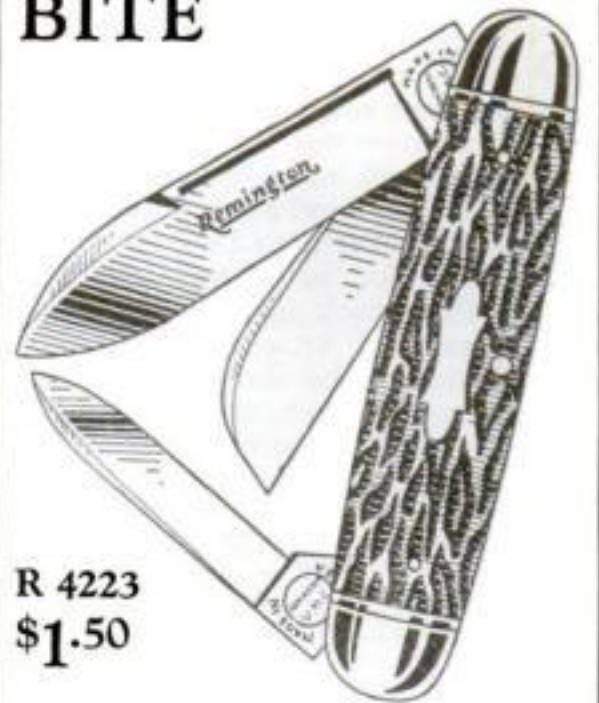
For the assembling you will need a small can of high-grade liquid glue and about half a pound of six-penny nails. Spread some glue in the lowest dado and insert the bottom piece. Turn the part over and nail securely, driving the nails at an angle so that they will hold well in the end grain. Proceed with the other parts, leaving the two back pieces until both sides are assembled.

Set the heads of the nails about $\frac{1}{8}$ in. below the surface. If the piece is to be lacquered, the nail holes can be filled with plastic wood putty at once, or with lacquer and whiting after the priming coat has been applied. If it is to be stained, the holes can be filled with stick shellac to match.



How the right-hand sidepiece is made.

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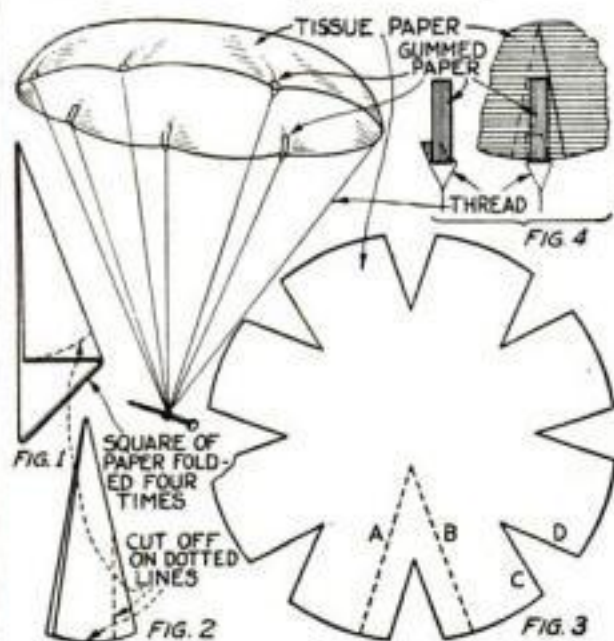
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Popular Science Monthly
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Paper Parachute Floats Long Distances

BY VIRTUE of its saucer shape and lightness, this tissue paper toy parachute will float a considerable distance in a light breeze when released from a second-story window. A square of any fairly tough tissue paper will serve. Make it as large as your paper will allow, or paste four squares together.

Take pains to fold the sheet carefully, starting with the diagonal, as in Fig. 1. Cut



How a square sheet of tissue paper is folded, cut, and pasted to make a toy parachute.

about one third of the way up the edge to make the V's (Fig. 2). Lap over just enough of the edges to hold securely. The one large V (Fig. 3) is necessary to give a conical shape.

Seven threads or strings are attached by means of gummed strips as in Fig. 4. Each thread should be about as long as the diameter of the paper before it was pasted. Tie the ends together and attach a nail, the size of which must be determined by experiment.—H. S.

Vault for Valuables

(Continued from page 94)

fiber and a cover was soldered on the rim. If you wish, you can have this work done by a tinsmith without letting him know the reason for it.

After the vault has dried for a week, a 2-in. layer of concrete was placed in it and the deep iron box forced into place.

One more form had to be made—a hollow form 3 by 18 by 20 in., with a bottom section 5 by 12 by 14 in. The top of the 18 by 20 in. section was open, but the bottom of the 12 by 14 in. section was closed. This form was built so that it could be taken apart easily. Wires were run through each section in both directions, spaced about 2 in. apart. All points where the wires cross were tied and, beginning at the bottom section, one end of the tie wire was carried to the top section and used to tie the top wires. This was done before the bottom boards were nailed on.

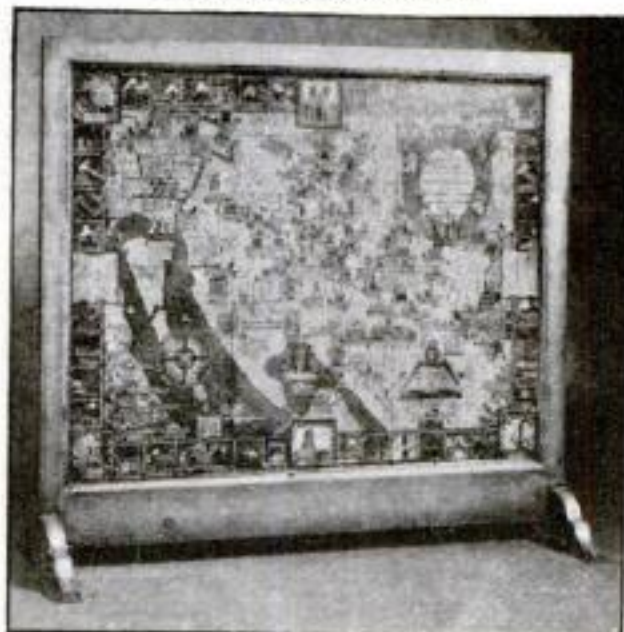
The form was filled with a wet mixture of 1 part cement and 4 parts clean, sharp sand, and lifting rings were imbedded in it. The concrete was allowed to harden for a week before the form was removed. The wires were then trimmed close.

The galvanized iron, asbestos-filled cap fits into the can, and the concrete cap fits into the hollow of the vault over this cap, and also covers the entire top of the vault.

To stop a small leak in a water pipe that is difficult to remove, cut a strip of inner tube, say $\frac{1}{2}$ in. wide and 2 ft. long, and wrap it around the pipe, keeping it stretched about as much as it will stand. Then bind with string.

Modernistic Fire Screen

See Le Page's Book, page 13



Cape Cod Chest of Drawers

See Le Page's Book, page 3

Christmas Gifts of Fine Furniture You Can Make Yourself...

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If you like to work with tools and are not acquainted with LePage's Home Work Shop Books, you are missing something. If you like fine furniture in your home, without paying big prices for it, you can easily make it yourself. Any piece described in the New Book would certainly make a great Christmas gift, and you would always be proud of the fact that you made it yourself.

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In addition to the three pieces shown above, the book includes the following: Alexandria Nest of Tables, Old Salem Ship's Cupboard, Plymouth Built-In China Closet, Lady Washington Sewing Cabinet, Set-Back Book Shelves, Modernistic Desk, Table, and Folding Screen, Chess and Checkers Table, Smoking Table, Caned Side Chair, China or Book Cabinet, Book Trough and Magazine Stand, Magazine Carrier, Book Stand, Fernery Stand and Folding Sewing Screen. Where else could you get complete directions for making all these for only 10 cents?

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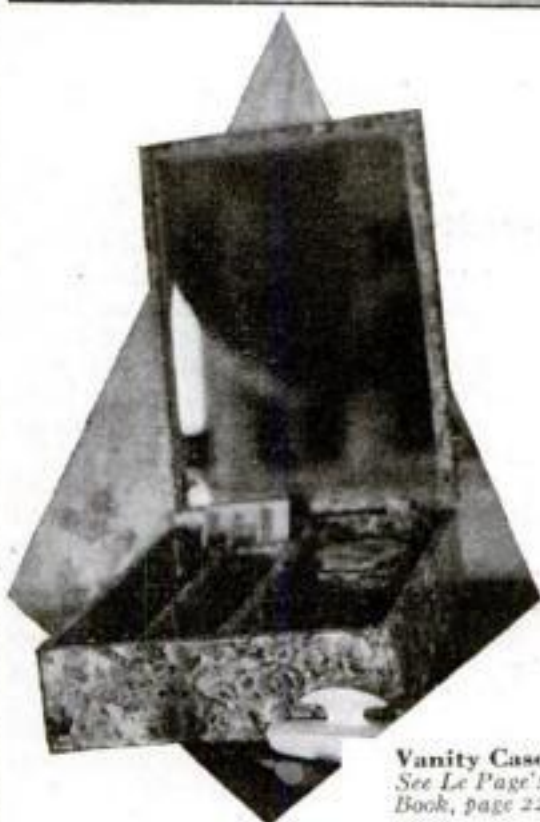
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Vanity Case
See Le Page's Book, page 22

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10-28

Hints on Rubbing Down Varnish and Enamel

AFTER expending much effort in building a piece of furniture or other cabinetwork and applying several coats of varnish, many home workers make the mistake of leaving the finish in a high gloss. The piece has a certain crude, glaring look, and if there are any imperfections whatever, each one seems to be magnified. To remedy this, it is necessary to carry the finishing process one step farther—really a simple and easy step, although one the amateur usually shirks. The surfaces should be rubbed with powdered pumice stone, grade FF or finer, and rubbing oil (or light machine oil or crude oil) to the soft, velvety and more artistic finish invariably found on fine furniture.

Besides the pumice stone and oil, you will need a painters' rubbing felt. If this cannot be obtained, use any scrap of thick felt you can find, but be sure it is clean and free from grit.

Dip the felt in the oil and then into a dish containing a little of the pumice stone. Rub the felt over the wood with long, even strokes. Work clear across from edge to edge and with the grain of the wood, as far as practical.

After a dozen or two strokes, strike off some of the sludge with your thumb and see if the surface has the dull, satinlike smoothness at which you are aiming. If not, rub lightly a little longer, but use plenty of oil and be very careful not to rub through the varnish at the edges. As the finish is always thin on sharp corners and edges, rub very lightly or not at all rather than run the risk of cutting through to the bare wood. Carvings can be rubbed dull by applying the oil and pumice stone with an old paint brush, cut off to make it stubby.

Wash the surfaces thoroughly with mild soapsuds, rinse with water to remove the oil and pumice stone, and dry with cheesecloth or damp chamois skin.

Pieces that have been enameled can be rubbed in exactly the same way, but use water instead of oil on the rubbing felt and take even more care not to rub too much.

Although it is rarely done, the better grades of brushing lacquer enamels, which are now so popular, can be rubbed to give them a still smoother appearance. In rubbing them, mild soapsuds are used instead of plain water.

A Fine Finish on Poor Wood

(Continued from page 92)

may be tinted with dry colors to match the finishing color which is to be used.

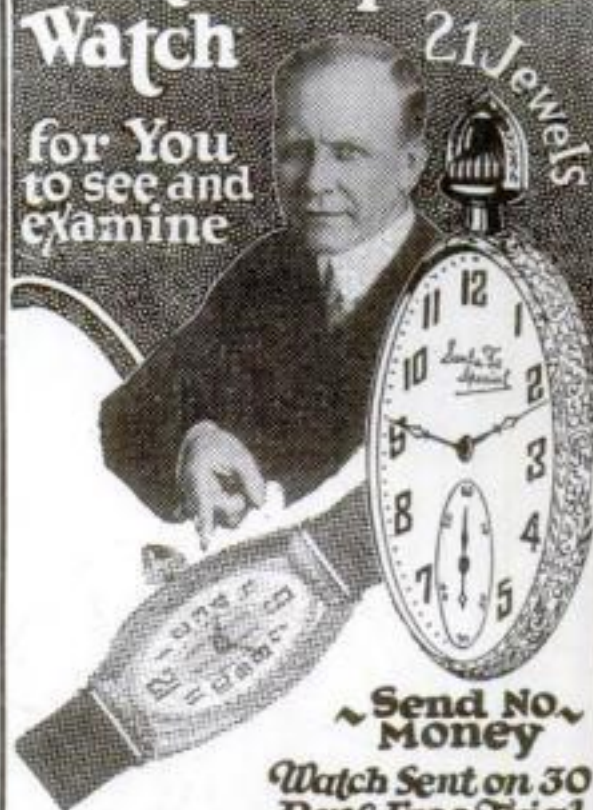
A putty mixed from white lead-in-oil paste, dry whiting, and a little floor varnish also can be used for filling dents in thin metal surfaces after the first coat of paint has been applied. It is, however, often better to hammer the dents out as smoothly as possible with a wooden mallet, if you are able to get at both sides of the metal, and then fill them with solder. The metal must be cleaned perfectly bright with emery cloth or sandpaper and a knife. Then apply solder until the dent is a little more than full, and afterward file the solder flush with the surface.

In putting new wood, the first requirement is that the wood be first given one coat of paint. For exterior surfaces a good putty can be made by mixing dry whiting with pure linseed oil, but a still better putty is made from white lead-in-oil and dry whiting. If it becomes too stiff, add a little linseed oil.

For interior wood surfaces a good putty can be mixed from any oil paint, white lead, or flat wall paint simply by adding enough dry whiting to make a plastic mass. Knead it well with your fingers and tint it with dry colors. This type of putty can also be used for woods which are to have a natural or stained finish, but it is best to mix the putty a shade darker than the natural or stained wood because the general color of the finish will ordinarily become a little darker with age.

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New Ways to Paint Radiators

(Continued from page 61)

color may be applied in the same way. The sponge should be washed out in gasoline and thoroughly cleaned with soap and warm water after it has been used with each color.

The other method of applying the stippling color is often termed polychroming. After the foundation coats have been applied, the stippling color is brushed on and worked into the scrolls and embossing of the radiator. Then it is wiped from the high spots with a cloth so that in some places only the foundation coat is seen, in others only the stippling coat, and in others a blend of the two.

FOR this work oil colors or specially prepared glazing or mottling colors, thinned with glazing liquid or flattening oil, are most satisfactory. The advantage of the prepared glazes is that they do not set up as rapidly as turpentine, and speed in handling them is not so necessary. The strength of the colors may be governed by varying the proportions of the thinner. In no case should too much surface be coated with a stippling color before the wiping off or mottling is done.

Two- or three-tone effects may be produced by spotting on two or three different colors at the same time and blending them together with a stippling cloth. The mixtures must be prepared in separate containers and put on with separate brushes. This treatment is, of course, especially suited where the wall decoration is Tiffany paint stippling, and it also goes well with mottled and blended wall papers and the new plastic wall paint finishes.

The highest efficiency in radiation is obtained with flat paints and enamels. There appears to be a very slight advantage in favor of the flat finishes over the enamels. Gold, bronze, and aluminum finishes (flake metal finishes) have been shown to be less efficient when applied to radiators because the surface does not dissipate the heat into the room as rapidly as it is transmitted through the metal of the coils. That does not mean that the metallic finishes must be removed from the radiator in order to allow it to release the maximum amount of heat. If coated over with any good paint or enamel, the surface will not retard the heat and the efficiency will be increased. The improvement will be from nine to (in a few special cases) eighteen percent, according to comparative tests of radiator finishes reported by William H. Severns, of the University of Illinois, in the "Journal of the American Society of Heating and Ventilating Engineers."

The new brushing lacquers also are of high efficiency in respect to the radiation of heat. They are very nearly the equal of flat wall paint; and, like it, they will withstand the heat to which radiators are subjected.

The hand, foot, electric and vacuum-cleaner paint sprayers now so common are especially adapted for use in finishing radiators, which have so many irregular surfaces and hard-to-get-at places. The wall behind and the floor beneath, of course, must be thoroughly covered, and the painting material has to be used in a thinner consistency than for brush coating.

After being decorated, the radiators should be warmed up slowly the first time they are used to allow the finish to bake slowly on the surface.

GAS ranges, after several years' service, sometimes develop leaks around the valves or taps. Turn off the gas at the meter, remove the valves from the manifold, and take them apart. Remove the pin or stop so that the valve will turn completely around. With a paste made from any ordinary kitchen cleanser and water or with regular valve-grinding compound, proceed to grind in the valves as if they were automobile valves. Clean all parts before re-assembling and stretch the tension spring slightly.—FRED W. HARTON.

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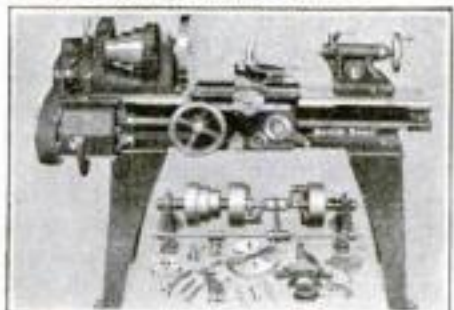
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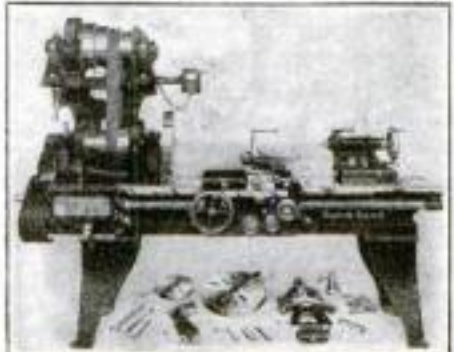
A small down payment brings you the Lathe to use while you are paying for it. We ship immediately upon receipt of the down payment.



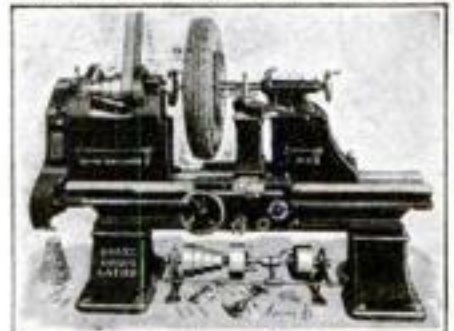
9" x 2 1/2' Junior Back Geared
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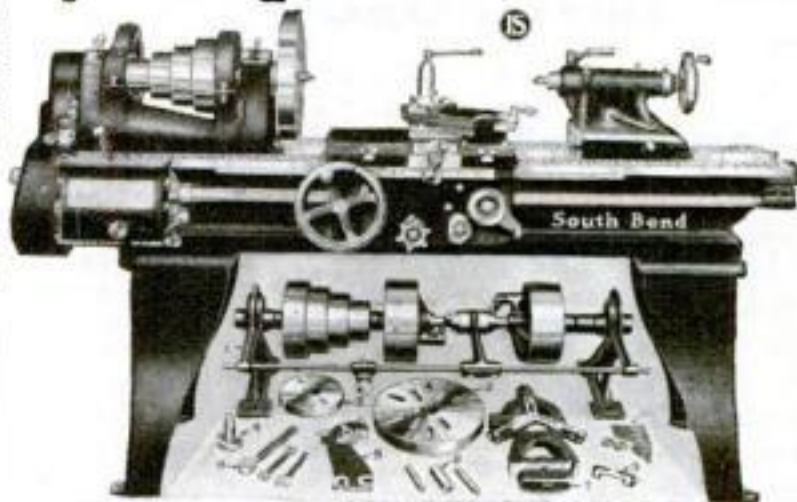
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An' a-thinkin', dear of you;
An' a candle's burnin' brightly,
An' it says your love is true.
For the days are long, of waitin',
An' the nights are longer still,
An' sometimes (Always smokin')
I pick up this old quill—
An' try to write some poetry
To tell you of my love.
As poetry it ain't much good,
But—holy days above—
It's jest the best I can, an' so
You'll find me, when I'm through.
Jest a-sittin', smokin' Edgeworth,
An' a-thinkin', dear, of you.

"J"

There's only one way to find out whether Edgeworth is *your* tobacco. That is—try it. Find out for yourself what makes smokers sit down and write

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[On your radio—tune in on WRVA, Richmond, Va.,
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meters. Frequency 1180 kilocycles]



Candlestick Turning

(Continued from page 116)

Place one leg on the center and scribe the circle with the other while the stock is revolving.

Another way is to set the dividers to the required diameter. Rest one leg of the dividers on the T-rest and place it in contact with the revolving stock. Bring the other leg of the dividers gradually in contact with the stock. If two circles are marked, shift the dividers so that the points come in contact with the stock halfway between the two circles, when only one circle will be marked (Fig. 4).

The second method is more exact and is especially useful when the center has been cut away. It is very quickly mastered.

Reduce the base to the required diameter as explained above. Then adjust the T-rest parallel to the lathe bed and to the edges of the base, and with the square-nose chisel remove the thin piece of material left on the rear edge of the base.

NEXT mark a pencil line all around the base to represent the thickness of the part which is to be of the greatest diameter. To make the explanation simpler to follow, the base of the candlestick shown at the left in Fig. 5 will be used as an example. The line just mentioned will accordingly be $\frac{3}{8}$ in. from the rear face of the base (see Fig. 6).

Change the T-rest to its first position (parallel to the face of the base); set the calipers to $3\frac{3}{8}$ in. and mark another circle with the dividers as described above. Cut down to the pencil line with the skew chisel on this diameter ($3\frac{3}{8}$ in.). Set the dividers to $\frac{7}{8}$ in., mark the circle, and cut the concave curve between this circle and the one previously marked ($3\frac{3}{8}$ in.). To do this, adjust the T-rest at an angle and as near to the surface being turned as possible. Cut the square bead and round off the corners on the $\frac{4}{8}$ in. part with a skew or square-nose chisel.

With the dividers, mark the diameter of the hole in which the tenon of the upright piece is to fit. Cut on the inside of the line with the toe of a $\frac{1}{4}$ -in. skew chisel and remove the center with the skew chisel or a round-nose chisel (Fig. 3). Cut the hole so that the tenon fits snugly.

Leave the base as it is in the lathe, put a little thin glue on the tenon and in the hole, and fit the tenon in place. Clamp the base and the upright together in the lathe by pressing the dead center into the plug in the end of the upright. Wipe off any surplus glue with a piece of waste moistened with hot water, and leave the candlestick to dry in the lathe.

SANDPAPER and stain the candlestick to the desired color. If a water stain is used, it is well to wet the wood before applying the stain. The water raises the grain, making it feel rough to the touch, and it is therefore necessary to sand the candlestick again when it is dry. It will be found that the wood will dry more rapidly if the lathe is running. A second wetting of the wood with water stain will not raise the grain.

If the wood is very porous, such as oak or Philippine mahogany, it should be filled with paste wood filler thinned with turpentine until of the consistency of cream. Apply it to the candlestick with a brush. After a little while it will lose its luster and become flat. The lathe then should be run at its slowest speed while the filler is rubbed into the pores of the wood with a cloth. Wipe clean with a piece of waste, and allow the filler to dry for twenty-four hours.

A thin coat of shellac as an undercoat for the finish next should be applied with a brush. On relatively close-grained woods, such as birch or Santo Domingo mahogany, the filler coat may be omitted and the shellac coat applied directly after the stain has dried.

The shellac

(Continued on page 133)



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How to Preserve Hardware

HINGES, locks and other hardware for use in the bathroom, laundry, kitchen, and other rooms where there is considerable condensation of moisture, should never be of iron or steel unless well protected against rust by paint, enamel, or galvanic coating. Plated ware will seldom stand up in such places unless the plate is exceptionally heavy. The best hardware is brass, copper or bronze, but if iron or steel fittings are used, they should be protected by two coats of red lead in oil, followed by the color and material you wish to use in your decorative scheme.

Hinge bolts should be sparingly lubricated about twice a year with a light nongumming oil. This prevents rust on the bearing surfaces and causes the doors to work smoothly and quietly. Do not oil locks because dust and lint will collect and perhaps cause them to stick.

If a lock works hard, take it apart and clean it with kerosene, wipe with an oily cloth, and replace. Should this fail to cure the trouble, the lock may be binding in the mortise, or the strike plate may be out of place.

Sometimes lock springs become weak and fail to throw the bolt out. I have found a piece of spring from an old alarm clock or a cheap watch to work well as replacements for weakened lock springs.—V. G. WARREN.

Candlestick Turning

(Continued from page 132)

should be allowed to dry for several hours. The lathe then may be started and this coat rubbed down with No. 00 steel wool. Be careful not to rub through the stain on sharp edges and beads.

Next a coat of clear lacquer may be brushed on evenly. Do not brush twice over the same place. The lacquer, which dries very quickly (within an hour), may be rubbed down with No. 5/0 waterproof sandpaper or powdered pumice stone sprinkled on a rag dipped in soapsuds or rubbing oil (crude oil). If a higher gloss is desired, two coats of lacquer may be applied, only the second coat being rubbed. Do not use an oil stain or oil in any form under a lacquer finish.

A thin coat of liquid wax also adds to the luster. This is applied with a piece of cotton waste or a rag and polished with a flannel cloth while the work is revolving in the lathe.

THE candlestick is now finished. The plug is removed from its upper end (a pair of gas pliers may be helpful for this purpose), and the faceplate is unscrewed from the base. The holes left by the screws may be plugged by filling them with wood cement or stick shellac. This is sold in all colors; it looks like sealing wax and is melted in the same way.

A piece of thin felt may be glued to the base. Apply the glue to the bottom of the base, *not to the cloth*, press the cloth in place, and set away to dry. The edges of the cloth may be trimmed later with a pair of scissors.

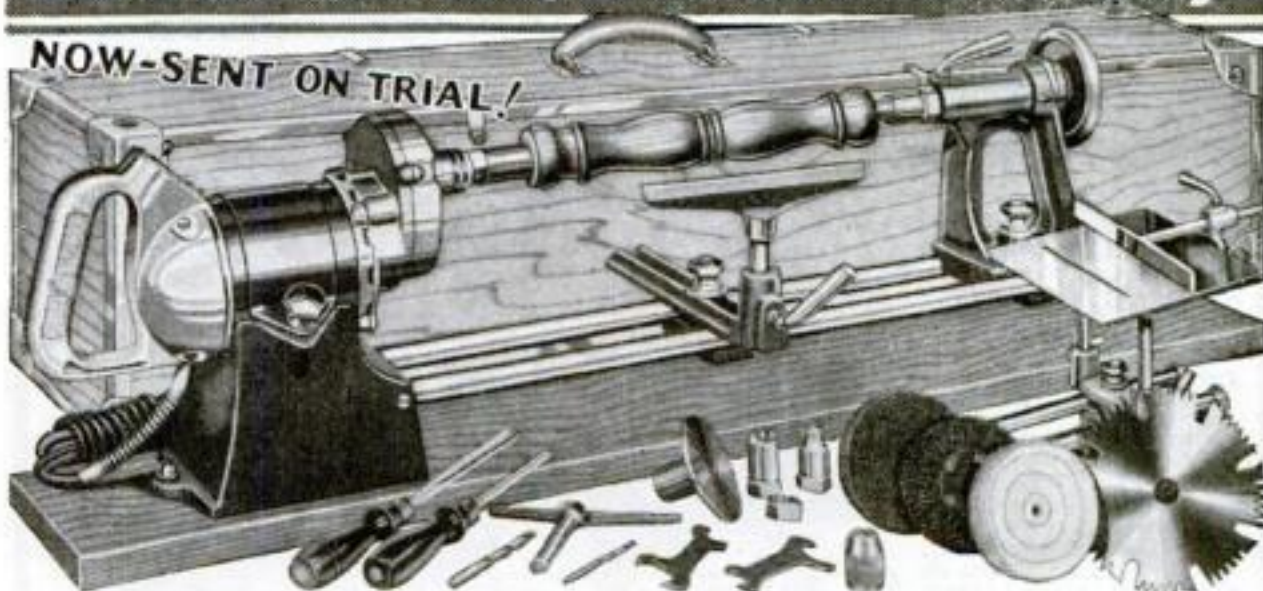
Another method of turning the base, so as to avoid the screw holes, will be explained in the next article in this series.

This is the seventh of a series of articles for the home worker who owns a wood-turning lathe. The next article, which is scheduled for early publication, will give designs for a table lamp and a smoking stand.

IF A floor or a piece of furniture has been bruised or the wood torn away, either fill the depression with putty or some substitute, plane the surface down until the bruise is removed, or apply a pad wet with hot water. The water application must be renewed frequently, and a hot flatiron used on the pad will help in stubborn places. With patience, the worst bruise may be raised this way if no wood is missing.—C. A. K.

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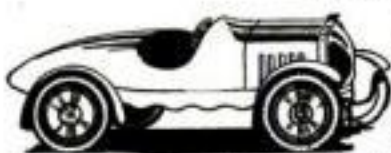
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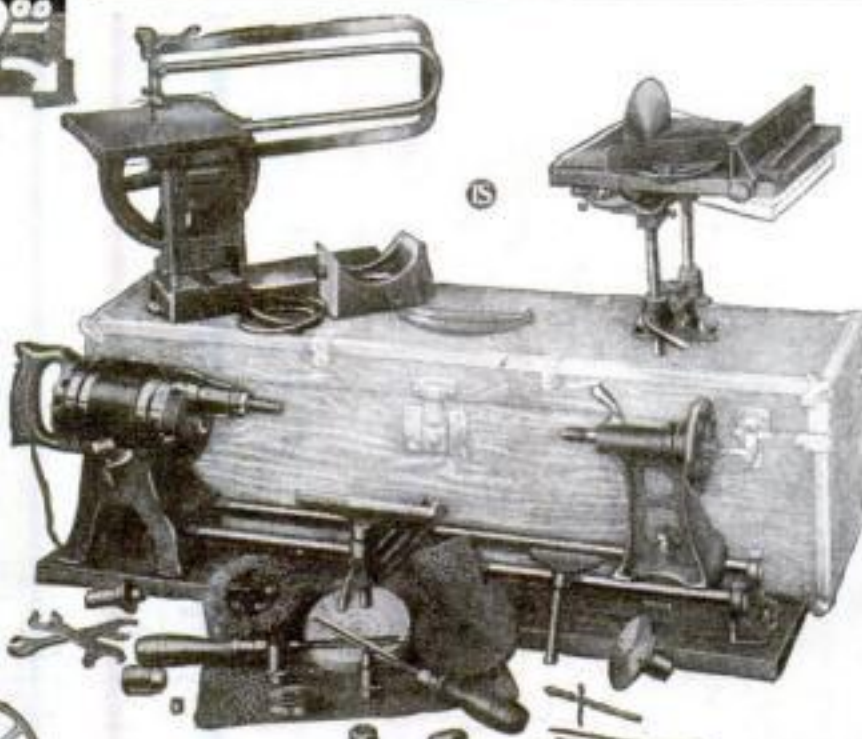
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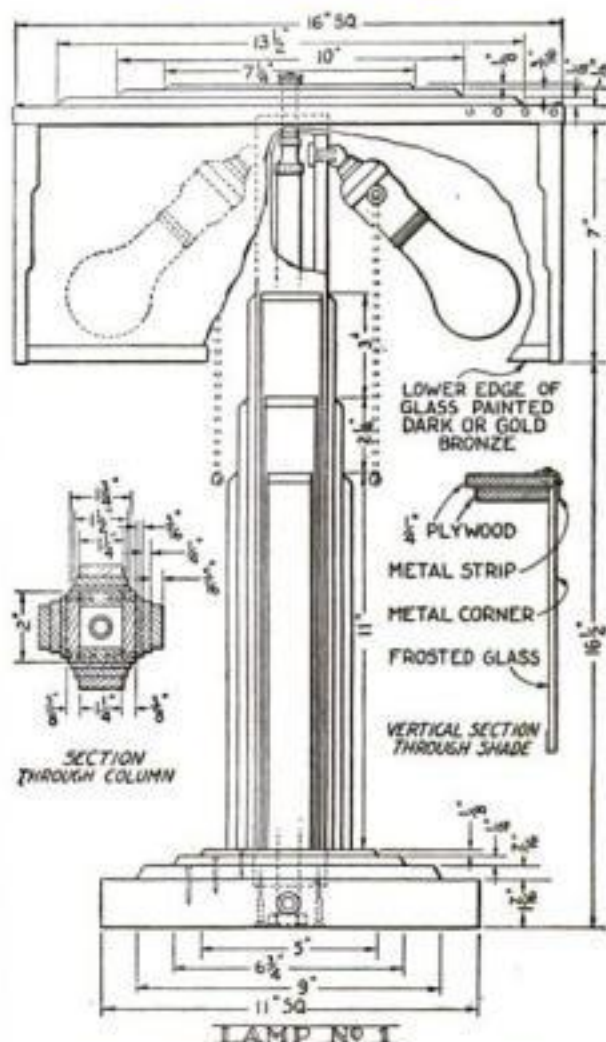
Manager, Dept. 20. Without any obligation, please send me all particulars
about your shop, 10-day free trial, free blueprints, free crafts course, also
\$10.00 down payment offer.

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Modernistic Lamps

(Continued from page 59)



How the lamp illustrated on page 59 is con-
structed. The parts are nailed together.

laced together through holes along the edges.
It comes in various modernistic patterns
and in white, yellow, and green. The cost,
unfortunately, is high—from \$9 to \$10 for a
large sheet—but a table lamp of this style is
worthy of a very fine modern shade, and it
would be a mistake to use a cheap, common-
place commercial shade. Cloth printed in vari-
ous modernistic patterns and, of course, wire
shades of suitable shapes are sold in many large
department stores and artware shops.

Another suggestion for making an individual
lamp shade is to buy stiff shellacked buckram,
bend it over a suitable (Continued on page 135)

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Yellow or White Gold inlaid in
Genuine **HOPE RUBY** or **Black
Onyx**. Mention if desired in
solid white gold or green gold,
same price. Also give Initial
or Emblem desired and finger
size.

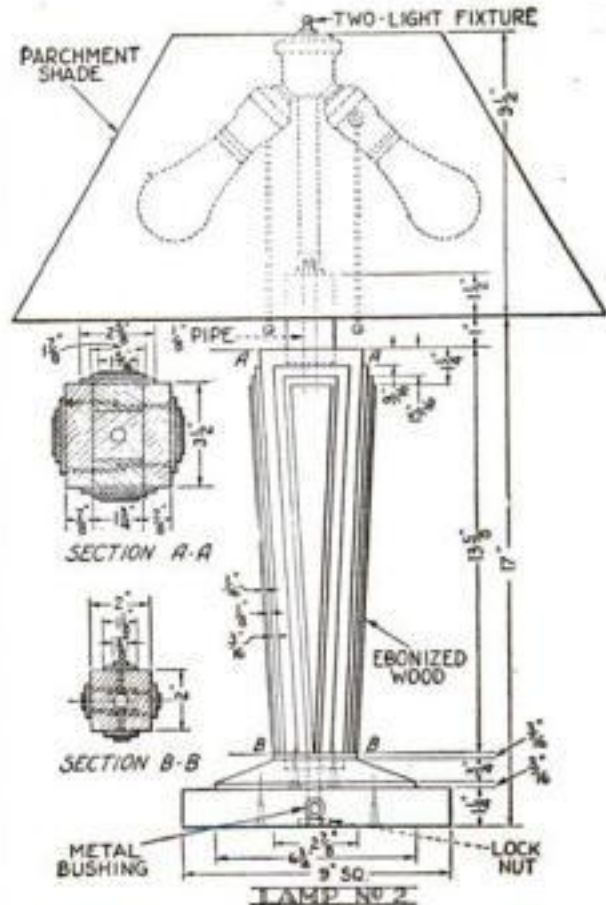
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Equally modern, this lamp can be used
with a ready-made parchment shade.

Modernistic Lamps

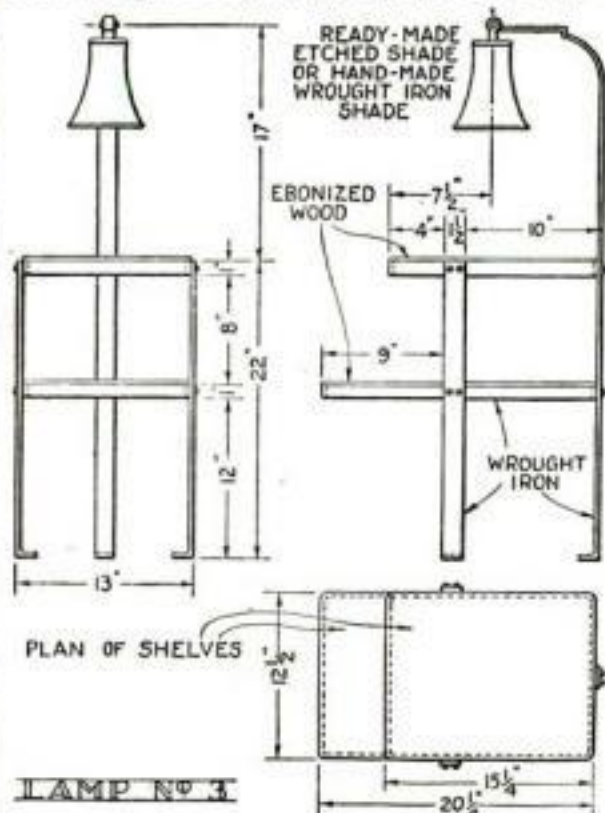
(Continued from page 134)

wire frame, and sew it in place. This is manufactured in a golden color and may be decorated with designs executed in brushing lacquers.

The third lamp is really more of a stand than a lamp and is an example of the modern combination of wood and metal. It can be used for smoking accessories, for holding magazines, or what you please.

Two rectangular iron frames are bent and riveted to three legs, one of which is extended to form the lamp standard. To the amateur craftsman accustomed to handling metal, it would be a simple matter to make this metal work; others can have it done at little expense by a blacksmith. It is obvious that the ends of each of the frames which support the two shelves should meet where the joint will be covered by one of the legs.

The stand is intended to be made of $\frac{1}{4}$ by 1 in. wrought iron, but $\frac{3}{8}$ -in. band iron may be



Combination lamp and stand with two shelves for smoking accessories or for books.

used instead of $\frac{1}{4}$ -in., and the bends made without heating. The ends of the legs, however, and the lamp standard should be heated in a forge to make a satisfactory and workman-like job. Bolts may be substituted for rivets in order to facilitate the construction.

The shelves are made of two pieces of wood glued together. One fits into the frame and the other, which is $\frac{1}{2}$ in. larger each way, rests on top of it. The top piece in each case should be made of ebonized wood or imitation ebony, as it is also called. If this cannot be obtained, a jet black stain can be made by dissolving nigrosine crystals in hot water. If the ironwork is silvered, the black wood forms a striking contrast.

An etched shade, which can be bought ready-made, may be used, or any appropriate type of shade. Those who have had sufficient experience in decorative metal work, however, will prefer to develop a shade in wrought iron to harmonize with the framework.

The next article in this series on modernistic furniture and accessories will tell how to make skyscraper book ends, a hanging bookshelf, and a low stand. Besides the blueprint showing the lamps described in this month's article, two other modernistic furniture blueprints are available—No. 88, which contains drawings for a book and magazine stand and also for a skyscraper bookcase, and No. 91, which gives a large variety of designs for folding screens.



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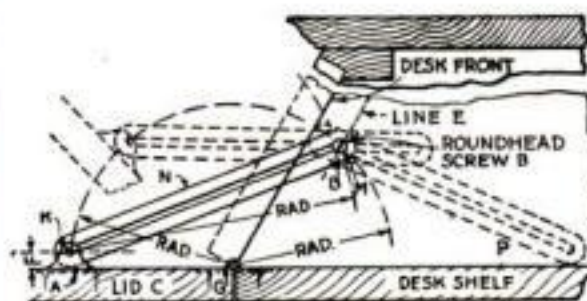
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How to Fit a Support for a Desk Lid

IF A lid support is fitted by the trial and error method, it is quite certain that the lid where plate A is attached, or the desk at screw B, or both, will be marred during the process. This particular type of lid support, nevertheless, can be more easily fitted than some other styles and it may be used at either the right or the left end of the lid.

To apply it, first make a full size drawing showing the line of the lid C and the angle of the desk front. Draw line E about $\frac{3}{4}$ in. from the edge of the desk, or the distance which will allow the plate A to clear the roundhead screw B when the lid is closed. Indicate the



Amateurs often find it difficult to attach supports; this diagram shows the correct method.

distance F and locate the center of the desk hinge pin at G.

Measure the distance from the center of pivot K and the end of the slot of brace N and mark it on the edge of a piece of paper. With the point K on line F, and point M, representing the other end of the slot, on line E, move the paper until K and M are equal distances from the center of the hinge G, or on an arc of the radius shown. Points B and K are then transferred to the desk and the lid.

Fasten A on the lid or cut the plate in, as preferred, and drive screw B so the brace N will work freely.

If the work has been accurately done, the end of brace N at P will just clear the desk shelf. If point K is moved $\frac{1}{8}$ in. toward G and point B moved $\frac{1}{8}$ in. away from G on their respective center lines, the end P of the brace will swing well above the shelf.—C. K.

How to Patch Old Furniture

(Continued from page 96)

egar that has not been absorbed by the wood. Although this treatment will not actually remove the old glue, it will insure the adhesion of new glue.

Thoroughly dry (by heat) the blister and adjacent wood and make all preparations for clamping. Again lift the edge of the veneer, introduce enough glue to cover well but not too heavily the core side of the joint, and spread the glue with a thin, flat tool such as a long-bladed putty knife, spatula, steel kitchen knife, or an old corset rib, which is best of all. Replace the lifted edge of veneer, cover with several layers of paper, and set the clamps with uniform pressure. When the clamps are removed and the paper scraped off, there will be no blister; and if the incision followed the grain exactly, it will be invisible.

When patching small defects in veneer, the templet method should be used, as explained in a previous article (July issue, page 96), but both the "grave" and the patch should be marked out with a sharp-pointed knife and worked exactly to the line. Cut the patch with shears as if cutting paper. The clamps illustrated in the July and August articles are excellent for use in veneer work.

This is the fifth in a series of articles by an expert of many years' experience in the repair of antique furniture. The next article will appear in an early issue.

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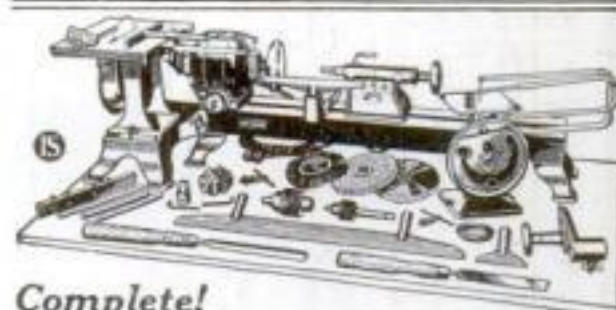
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Advice for POPULAR SCIENCE readers regarding safe and profitable investments. See Page 4.

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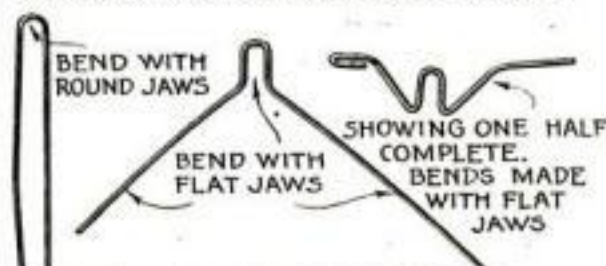
(Continued from page 82)

a very soft and almost grainless white pine should be used. The planing mill can saw the blanks for you on a band saw and also saw the taper on toothpick propellers. Always make a paper pattern of the blade outline before marking the wood so that your blank will be accurate. It is well to have on hand a few 10- and 12-in. toothpick blanks and 8-, 10-, and 12-in. club blanks.

Always drill the center hole before beginning the actual carving. Accurately



STEPS IN MAKING PROPELLER HANGER



STEPS IN MAKING WING CLIPS



Fig. 2. Steps in making piano wire fittings—propeller hanger, wing clip, and wing saddle.

locate a dot on each side of the blank where the hole is to be. Force a brad straight into the hub about two thirds through; then turn the blank over and do the same on the other side. With very little practice the beginner can make holes accurately through hubs by this method.

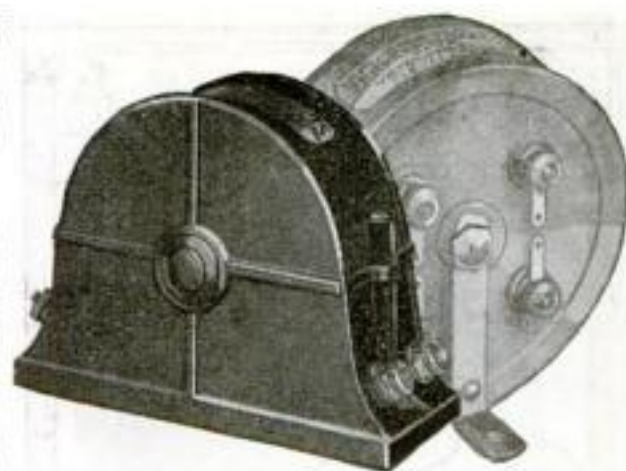
It is a good plan to blacken the edges of the blanks that are not to be cut away. This helps to keep from running over the edges and ruining the blades.

A line that is of great assistance in obtaining the proper cross section for the propeller blades may be drawn as follows: Lay a straightedge on the side of the blank that is to be convex from the center hole to a point at the tip of the blank which is one quarter the blank width from the entering edge, as made clear in Fig. 1. In carving cut up to this line; then, as a last finishing operation, trim away the ridge left there so as to round off the blade nicely. Remember not to overdo the cupping on the concave side; a very slight cup is all that is necessary. Balance the propeller carefully. This is important, as an exact balance will prevent vibration, which otherwise would impair the propeller's efficiency.

In a later article hints will be given on cutting true pitch propellers. These are harder to carve but are very light and efficient.

For very light models balsa wood can be substituted for white pine. Balsa wood veneer—thin sheets about 1/20 in. thick—is frequently used for wing ribs, as in the

(Continued on page 138)



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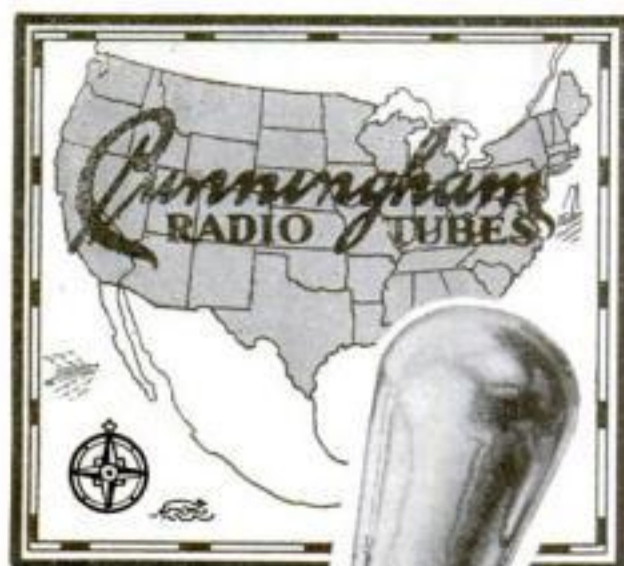
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RADIO TUBES

Models That Fly Farther

(Continued from page 137)

Bremen model and for the pontoons of sea-planes (Blueprint No. 87). Even the propeller can be carved from balsa at a saving in weight, although the wood is very soft and easily damaged. The hub of a balsa propeller must be a little wider when viewed from the front than a corresponding white pine propeller. A balsa motor stick must be somewhat larger, and the spars for an average 3-ft. model should be about $\frac{3}{8}$ in. thicker and $\frac{1}{8}$ in. deeper when made of balsa. A balsa model is more difficult to construct, but it flies on less rubber and is at once more delicate and more efficient.

In making the various piano wire fittings you will find a pair of pointed nose pliers with flat jaws and a pair with rounded jaws are helpful. By following the suggestions given in Fig. 2 you can form any desired type of wire fittings.

In assembling models do not overdo the thread binding. Very few wraps, if properly secured with a touch of an ambroid type cement, are sufficient.

EXTREME care should be exercised to align the wings and make sure they are square across the fuselage and have the same angle of incidence on each side. In single motored models give the left side of the wing a slightly greater angle of incidence by warping upward the leading edge before the glue sets, and let the frame dry this way. In tractors the same effect can be obtained by warping the rudder slightly to the right side. These expedients are to overcome the torque of a single right-hand propeller.

The use of a winder will help you obtain the maximum flying results from your models. By stretching the rubber to twice its normal length before you begin to wind, you can get from two to two and a half times as many turns without breaking the rubber as you can by any hand winding method.

The writers are sometimes asked why they recommend flying a plane with the wind when so frequently instructions are given to launch models against the wind. It has been their experience that down-wind launching, if properly done, is the better.

A model always should be balanced in calm air before attempting flights on windy days, but once a model is balanced, launch it at its flying speed plus the speed of the wind. The writers have flown models on days when it was so windy that one had to hold the wings to steady them and keep them from being torn away, while the other launched the ship, both releasing it at once.

In an ordinary breeze a model can be launched up-wind and will climb rapidly, wheel over and sail away at a good altitude, but as a steady "diet," here is the rule: launch down-wind at the model's flying speed plus the speed of the wind. A properly made and balanced model will start with a rush and climb powerfully.

For drawings illustrating the making of a "toothpick" propeller, see the article "Giant Model Airplane" in last month's issue (September, page 110).

Removing Floor Finishes

TO REMOVE old floor finish, apply ready-made paint remover with as little brushing as possible. When the finish has softened, remove it with a wide bladed scraper and, where necessary, a wire scrubbing brush. Corners which the brush cannot reach must be cleaned with the scraper. Benzine or gasoline will remove all the finish left. After being sandpapered, the floor will be ready for any finish excepting brushing lacquer, which can be safely applied to new floors only.

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A Small Bench

(Continued from page 58)

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Guides for drawers *N*, 6 pcs. 1 by 1 by $12\frac{1}{2}$ in.

Ends and back *P*, 18 pcs. ceiling, 20 in. long.

If you can visualize the work so clearly that you know just what each piece of lumber is for, it is not necessary to cut out all the pieces at once; in fact, a workman of experience probably pays little attention to these suggestions and will prepare only the material for the frame. However, it pays a beginner to lay out the pieces in advance as a safeguard against discovering during the course of the work that some boards have been ruined for their purpose by unwise cutting.

In the method of procedure, too, the expert and the amateur do not follow the same steps.

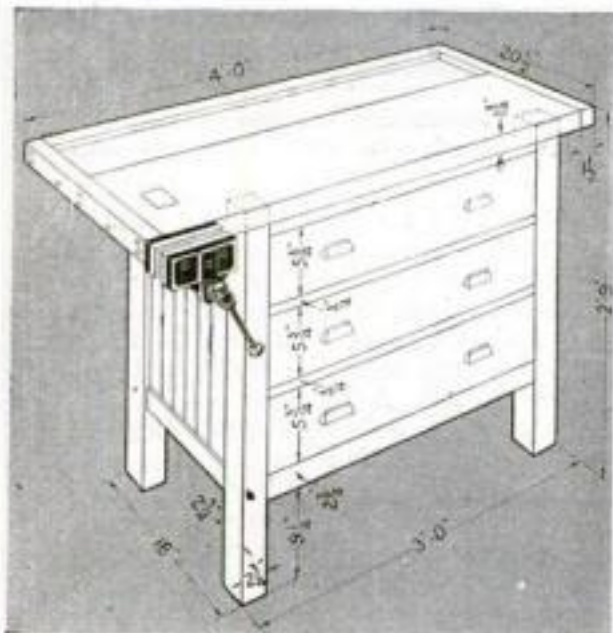


Fig. 5. The dimensions of the bench are especially suitable for the home workshop.

The method I would use in making the bench from this point is as follows:

Check up on the legs for squareness. If two adjacent sides can be found that are straight and reasonably square to each other, it is not necessary to do any planing, except possibly to clean the surfaces. If they are not square, it is better to plane them down in order to avoid future trouble.

Mark the two face sides of each leg thus selected and plane the other sides until all are the same size, working from the face corner.

Cut the legs to $31\frac{1}{4}$ in. in length, if the height of 33 in. has been accepted. A rather short person may like 32 in. better, and in that case the legs will be $30\frac{1}{4}$ in. The job then will be carried out exactly as shown in the drawing above, except that the distance below the lower rail will be $8\frac{1}{4}$ in.

It will probably be found that the legs are very nearly $2\frac{3}{4}$ in. square. If not, it is easier to make allowances in the plans than to reduce the legs to the exact size indicated.

True up the 2 by 3 in. rails on one side and both edges, if necessary, and mark the true face and one edge. Next, if a plow plane is available, run grooves the thickness of the ceiling, as shown in Fig. 2, on one edge of all of them except the lower front rail. Place the groove as in detail No. 1 of Fig. 7. If no plow plane is at hand, strips can be nailed on to receive the ceiling after the joints have been made. Cut the rails to such a length that $1\frac{3}{4}$ in. is allowed for a tenon on each end. Similarly prepare the three light rails for the front.

Lay out the mortises on the legs. Take care to calculate the reduction required on account of the depth of the grooves as shown in Fig. 4. The upper mortise must not come closer than $\frac{1}{2}$ in. from the top of the leg. Use $\frac{1}{2}$ -in. mortises, placed as in detail No. 2 of Fig. 7.

(Continued on page 140)

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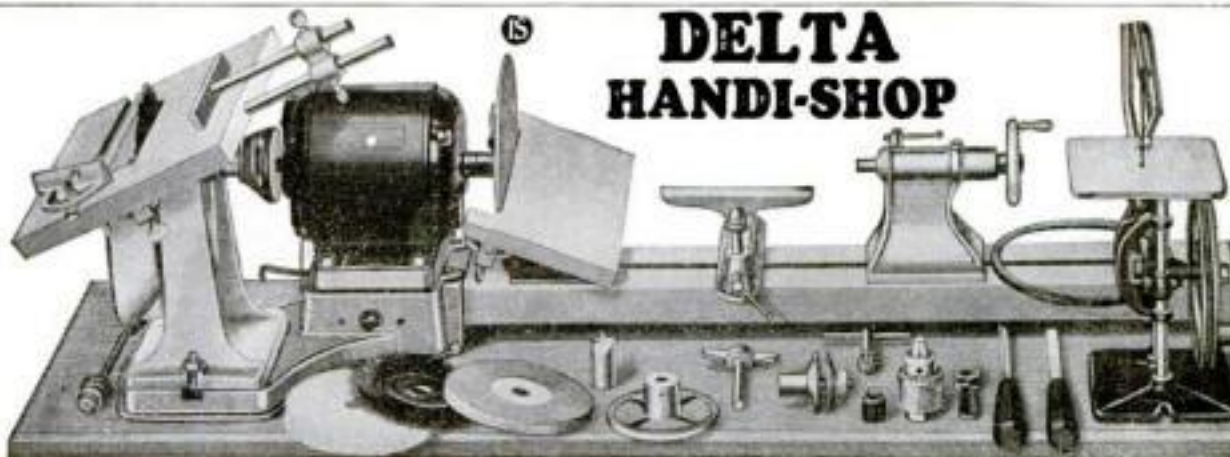
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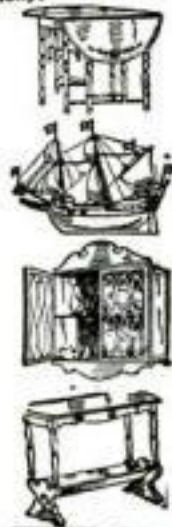
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A Small Bench

(Continued from page 139)

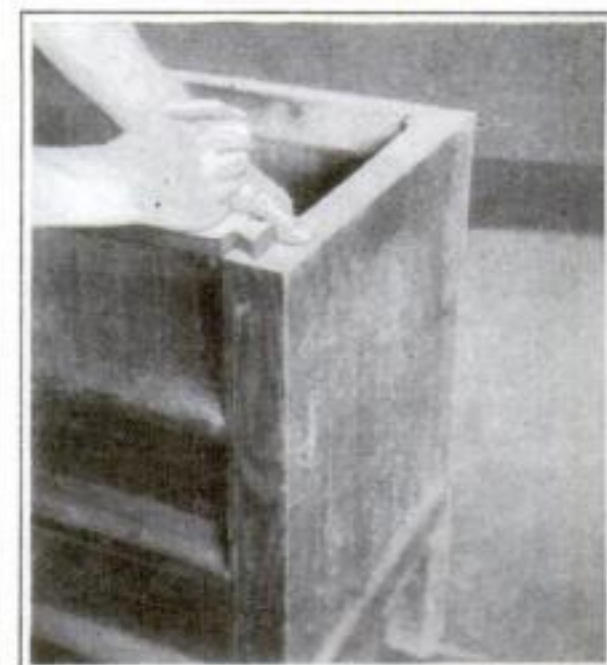


Fig. 6. Dovetailing the upper front rail
into the legs prevents them from spreading.

Bore out the mortises with a $\frac{1}{2}$ -in. auger
bit, making holes as close together as possible
and the entire length of the mortise. Then
clean out the hole along the sides with a wide
chisel, and at the ends with one $\frac{1}{2}$ in. wide.
In boring, care must be taken not to cut
through the leg. A bit gage is a convenient
tool to use for regulating depth. One can be
made by boring a hole through a piece of wood
of the right length and sliding it onto the bit.
Lay out and cut open mortises in each leg to
receive the drawer rails and runs as in detail
No. 3 of Fig. 7.

Lay out the tenons to fit the mortises, using
knife, square, and marking gage. Then cut ex-
actly to the lines with a rip saw for end grain
cutting and a crosscut saw for side grain cut-
ting. Some workers prefer to cut a distance
from the line with the saw and then chisel to
the line.

Now assemble the ends and back without
using glue, and nail in pieces $\frac{1}{2}$ by $\frac{1}{2}$ in., or
quarter-round molding, on the legs as shown
in Fig. 3, to receive the ceiling. These strips
can be left off until the entire job is assembled.

Cut the pieces of ceiling to length, allowing
not less than $\frac{1}{8}$ in. for clearance. Also trim
the last piece to correct width so that no delay
will occur in the final gluing.

THE upper rail on the front is fitted with a
dovetail joint as shown in Fig. 6. This is
easy to make and adds strength to the bench.

Cut tenons on the ends of the drawer rails
to fit the mortises in the legs as shown in
detail No. 3 of Fig. 7.

Assemble the ends first, using glue on the
tenons but not on the paneling. A good grade
of liquid glue is satisfactory. Pull the joints
together with bar clamps, if available, and be
sure to test the frame for squareness.

It is better to let the ends dry before as-
sembling the whole frame, but if the joints
are tight, or if clamps can be kept on the ends,
there is no need to wait. Put the two back
rails in place, insert the paneling as before;
then put the front rails in and set the second
end in place. Again, if clamps can be used, the
joints can be drawn up tighter. Put the top
rail on in front after the frame has been put
together.

Now make the top as shown in Fig. 5. The
end pieces are glued and screwed on with $3\frac{1}{2}$ -
in. screws. The bottom of the tool trough is
fitted into the frame and fastened with screws
(or nails) on one edge and the ends, and a
piece of quarter-round molding is laid around
it to close the joint. A more substantial job
would result from making the top piece from
narrow strips and

(Continued on page 141)

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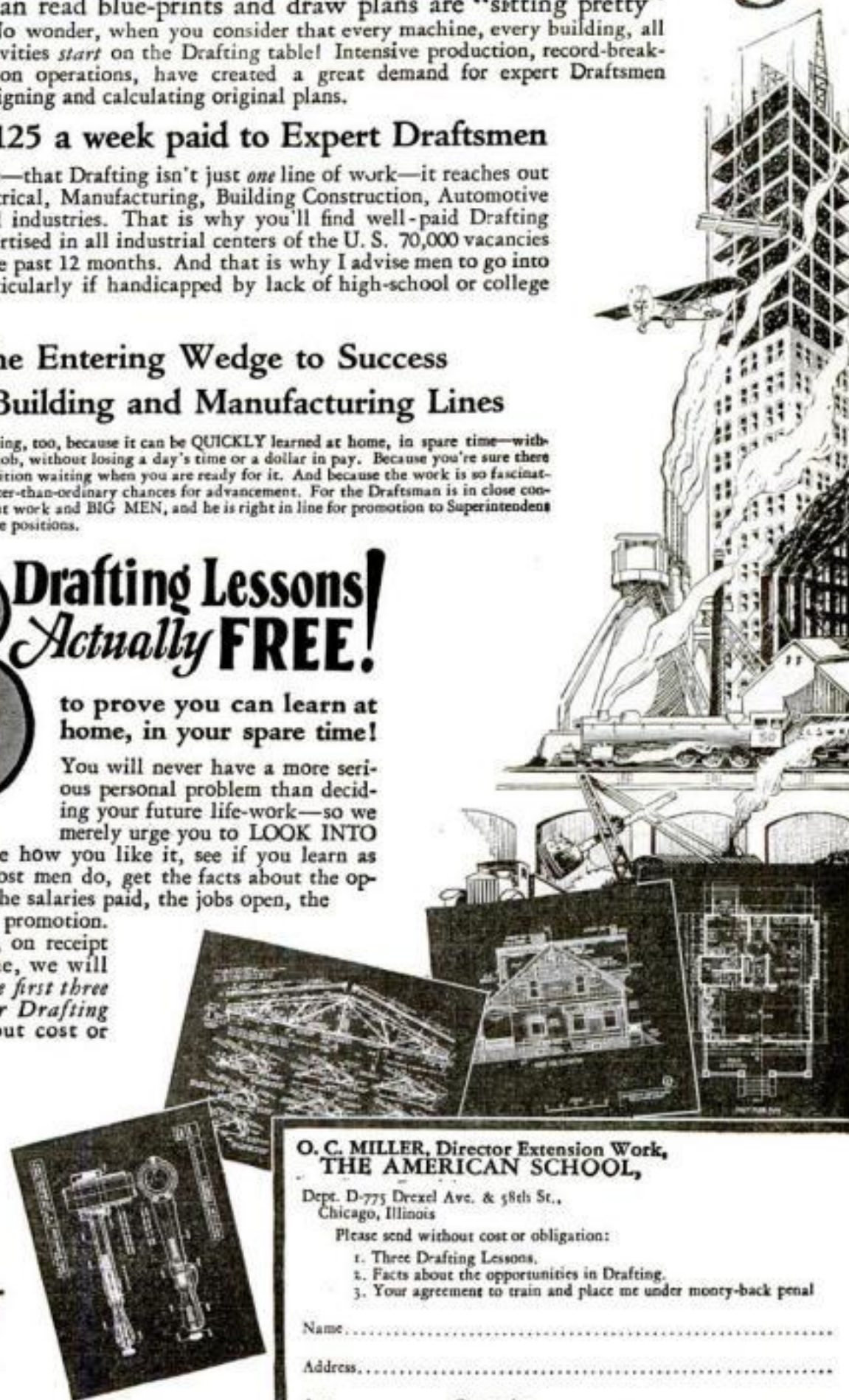
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Age..... Occupation.....

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Patent Attorneys

ADAM E. FISHER, Registered Patent Attorney in business 25 years; references: personal attention and promptness assured; Dept. E, 183 Enright, St. Louis, Mo.

INVENTORS. Consult Edgar M. Kitchin, Attorney at Law: Twenty years a specialist on Patents and Trade Marks. 805 G Street, N. W., Washington, D. C.

MONROE E. MILLER, Ouray Bldg., Washington, D. C., Patent Lawyer, Mechanical, Electrical Expert. Booklet and Priority Record blank gratis.

INVENTOR'S Guide sent free. Contains valuable information. Frank Ledermann, Registered Attorney-Engineer, Woolworth Building, 1714, New York.

PATENTS Procured. Trade Marks Registered.—A comprehensive, experienced, prompt service for the protection and development of your ideas. Preliminary advice gladly furnished without charge. Booklet of information and form for disclosing idea free on request. Irving L. McCathran, 201 Owen Bldg., Washington, D. C., or 41-Z Park Row, New York.

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CARL MILLER, Registered Patent Attorney (former Patent Office examiner), 211-M, McGill Building, Washington, D. C. Write for instructions.

INVENTORS who derive largest profits know and need certain simple but vital facts before applying for patents. Our book "Patent Sense" gives those facts free. Lacey & Lacey, 648 E. St., Washington, D. C. Established 1869.

PATENTS—Free instructions. Former Patent Office Examiner. Moderate terms. Booklet, Albert Jacobs, 725 Barrister Bldg., Washington, D. C.

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"U.S. PATENT No. 1,526,599 and Canada Patent No. 253,188 on a Moth Proof cabinet having removable sections on top. Mrs. Alice Hewett, 5321 Rosetta Street, Pittsburgh, Pa."

Photography Instructions

HAVE you a camera? Write for free sample of our big magazine, showing how to make better pictures and earn money. American Photography, 117 Camera House, Boston, 17, Massachusetts.

MAKE money in Photography. Learn quickly at home. Spare or full time. New Plan. Nothing like it. Experience unnecessary. American School of Photography, Dept. 1744, 3601 Michigan Avenue, Chicago.

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\$1250 FOR a Photoplay story by an unknown writer and sold through our Sales Department. We revise, copyright and market. Located in the heart of the Motion Picture Industry. We know the demand. Established 1917. Postal brings Free Booklet with full particulars. Universal Scenario Company, 214 Western and Santa Monica Bldg., Hollywood, California.

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HINTS on buying, installing and operating a radio outfit with list of tested reliable equipment contained in 24-page radio booklet of Popular Science Institute, 248 Fourth Avenue, New York. Price 25 cents.

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AGENTS—Clever invention! Inkspoon makes every pen a fountain pen. Fast office seller, big profit, demand increasing everywhere. Exclusive territory offered. Sample free. H. Marul Company, Tribune Bldg., New York.

GET our free sample case, toilet articles, perfumes and specialties. Wonderfully profitable. La Derma Co., Dept. F, St. Louis, Missouri.

AGENTS. \$60—\$200 a week. Genuine gold letters for store windows easily applied. Free samples. Liberal offer to general agents. Metallic Letter Co., 434-A N. Clark, Chicago.

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AGENTS—Best seller; Jem Rubber Repair for tires and tubes; supersedes vulcanization at a saving of over \$90 per cent; put it on cold, it vulcanizes itself in two minutes, and is guaranteed to last the life of the tire or tube; sells to every auto owner and accessory dealer. For particulars how to make big money and free sample, address Amazon Rubber Co., 504 Amazon Building, Philadelphia, Pennsylvania.

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SUCCEED With Your Own Products. Make them yourself. Formulas, Processes, Trade-Secrets. All lines. Catalog, circulars free. C. Thaxly Co., Washington, D. C.

BIG money and fast sales. Every owner buys gold initials for his auto. You charge \$1.50; make \$1.35. Ten orders daily easy. Write for particulars and free samples. American Monogram Co., Dept. 47, East Orange, New Jersey.

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HOUSEHOLD brushes, complete line, sample outfit and credit furnished to responsible men. National Fibre Broom Co., St. Louis, Mo.

THE Greatest Opportunity in Selling Field. Here are simple facts: A Tailoring Line. All Wool Goods. Made-to-Measure. Sensational Low Price. Money-Back Guarantee. \$25.00 Sales Outfit showing quarter-yard samples FREE. Also greatest book of selling helps ever put out. Write at once to Dept. 532, Madison Brothers, 131 South Peoria, Chicago.

MAKE money with Christmas Greeting Cards in Box Assortments. \$2.00 to \$4.00 per hour easily made. Nothing ever sold compares with the sale of Christmas Greeting Cards, sells on sight. Our magnificent Assortment contains 21 high grade Christmas Greeting Cards and Folders each with envelopes, steel engraving, French water coloring, sparkling metallic, gold and silver effects, panelling, and bordering. Sells for only \$1.00, cost you 50c. Write immediately for full particulars and free samples. Waltham Art Publishers, 7 Water St., Dept. U. O. Boston, Mass.

AGENTS—Steady income. Large manufacturer of handkerchiefs and linens, wishes representative in each locality. Factory to consumer. Big profits, honest goods. Credit given. Send for particulars. Freeport Mfg. Co., 21 Main St., Brooklyn, N. Y.

BIG bunch mail. Year 15c. Catalogues, magazines, Kentucky Agency, Covington, Kentucky.

BIG pay every day, showing Nimrod's All-Year Seller Dress, Work, and Flannel Shirts, Overalls, Pants, Sweaters, Underwear, Pajamas, Leather Coats, Lumberjacks, Playsuits, etc. Experience unnecessary. Big Outfit FREE. Nimrod Co., Dept. 25, 4922-28 Lincoln Ave., Chicago.

WE HAVE a line of goods for which every man in America is a prospect. Can be handled with tremendous profit by any salesman now selling to men. \$20.00 Outfit Free. Address Dept. 672 Sales Manager, 844 West Adams, Chicago.

SALESMAN handling hardware; paint; sporting goods and automobile accessory dealers, for fast selling sideline specialty; commission basis. Manufacturer: 1186 Grove Street, Irvington, New Jersey.

I PAY my agents \$90 a week just to wear and show my beautiful new Free raincoat and give away Free hats. Write today for yours. Robert King, 230 So. Wells, Dept. AC-10, Chicago.

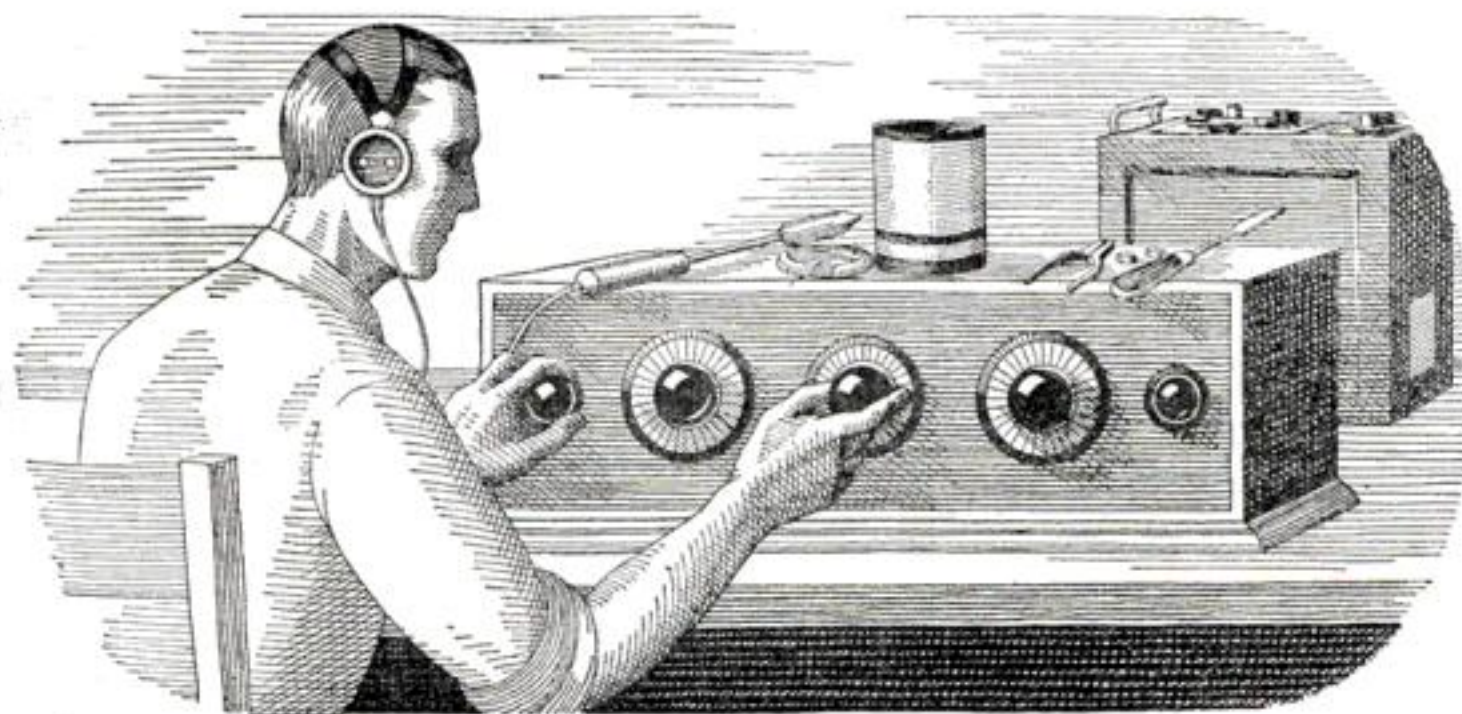
AGENTS \$300 month. Bonus besides. Sell guaranteed silk hosiery. Must wear 7 months or replaced. We furnish auto. Write for samples. Free silk hosiery for your own use. Betterknit Hosiery Co., Silk 1232, Greenfield, Ohio.

MAKE \$12 a day and liberal bonus selling Pioneer \$23.50 and \$33.50 all wool tailoring. Commissions paid daily. 100 extra large cloth samples furnished. We train the inexperienced. Write Pioneer Tailoring Co., Congress and Throop, Dept. X-1121, Chicago.

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GOLD Leaf window Letters and Script Signs. No experience; 500% profit. Samples free. Meyer writes—5 days—profits \$141.36. Consolidated, 69-Y West Van Buren, Chicago.

NOW free to agents. Amazing new self-wringing mop loaned free for ten-day test. Women buy on sight. Turn handle—make \$75 weekly. Sample sent on receipt of name. No deposit. Write Delphos Mop Co., M-60 Oak St., Delphos, Ohio.



If all the Radio sets I've "fooled" with in my time were piled on top of each other, they'd reach about halfway to Mars. The trouble with me was that I thought I knew so much about Radio that I really didn't know the first thing. I thought Radio was a plaything—that was all I could see in it for me.

I Thought Radio Was a Plaything

**But Now My Eyes Are Opened, And
I'm Making Over \$100 a Week!**

\$50 a week! Man alive, just one year ago a salary that big would have been the height of my ambition.

Twelve months ago I was scrimping along on starvation wages, just barely making both ends meet. It was the same old story—a little job, a salary just as small as the job, while I myself had been dragging along in the rut so long I couldn't see over the sides.

If you'd told me a year ago that in twelve months' time I would be making \$100 and more every week in the Radio business—whew! I know I'd have thought you were crazy. But that's the sort of money I'm pulling down right now—and in the future I expect even more. Why only today—

But I'm getting ahead of my story. I was hard up a year ago because I was kidding myself, that's all—not because I had to be. I could have been holding then the same sort of job I'm holding now, if I'd only been wise to myself. If you've fooled around with Radio, but never thought of it as a serious business, maybe you're in just the same boat I was. If so, you'll want to read how my eyes were opened for me.

When broadcasting first became the rage, several years ago, I first began my dabbling with the new art of Radio. I was "nuts" about the subject, like many thousands of other fellows all over the country. And no wonder! There's a fascination—something that grabs hold of a fellow—about twirling a little knob and suddenly listening to a voice speaking a thousand miles away. Twirling it a little more and listening to the mysterious dots and dashes of steamers far at sea. Even today I get a thrill from this strange force. In those days, many times I stayed up almost the whole night trying for DX. Many times I missed supper because I couldn't be dragged away from the latest circuit I was trying out.

I never seemed to get very far with it, though. I used to read the Radio magazines and occasionally a Radio book, but I never understood the subject very clearly, and lots of things I didn't see through at all.

So, up to a year ago, I was just a dabbler—I thought Radio was a plaything. I never realized what an enormous fast-growing industry Radio had come to be—employing

thousands and thousands of trained men. I usually stayed home in the evenings after work, because I didn't make enough money to go out very much. And generally during the evening I'd tinker a little with Radio—a set of my own or some friend's. I even made a little spare change this way, which helped a lot, but I didn't know enough to go very far with such work.

And as for the idea that a splendid Radio job might be mine, if I made a little effort to prepare for it—such an idea never entered my mind. When a friend suggested it to me one year ago, I laughed at him.

"You're kidding me," I said.

"I'm not," he replied. "Take a look at this ad."

He pointed to a page ad in a magazine, an advertisement I'd seen many times but just passed up without thinking, never dreaming it applied to me. This time I read the ad carefully. It told of many big opportunities for trained men to succeed in the great new Radio field. With the advertisement was a coupon offering a big free book full of information. I sent the coupon in, and in a few days received a handsome 64-page book, printed in two colors, telling all about the opportunities in the Radio field and how a man can prepare quickly and easily at home to take advantage of these opportunities. Well, it was a revelation to me. I read the book carefully, and when I finished it I made my decision.

What's happened in the twelve months since that day, as I've already told you, seems almost like a dream to me now. For ten of those twelve months, I've had a Radio business of my own. At first, of course, I started it as a little proposition on the side, under the guidance of the National Radio Institute, the outfit that gave me my Radio training. It wasn't long before I was getting so much to do in the Radio line that I quit my measly little clerical job, and devoted my full time to my Radio business.

Since that time I've gone right on up, always under the watchful guidance of my friends at the National Radio Institute. They would have given me just as much help, too, if I had wanted to follow some other line of Radio besides building my own retail business—such as broadcasting, manufacturing, experimenting, sea operating, or any one of the score of lines they prepare you for. And to think that until

that day I sent for their eye-opening book I'd been wailing "I never had a chance!"

Now I'm making, as I told you before, over \$100 a week. And I know the future holds even more, for Radio is one of the most progressive, fastest-growing businesses in the world today. And it's work that I like—work a man can get interested in.

Here's a real tip. You may not be as bad off as I was. But think it over—are you satisfied? Are you making enough money, at work that you like? Would you sign a contract to stay where you are now for the next ten years—making the same money? If not, you'd better be doing something about it instead of drifting.

This new Radio game is a live-wire field of golden rewards. The work, in any of the 20 different lines of Radio, is fascinating, absorbing, well paid. The National Radio Institute—oldest and largest Radio home-study school in the world—will train you inexpensively in your own home to know Radio from A to Z and to increase your earnings in the Radio field.

Take another tip—no matter what your plans are, no matter how much or how little you know about Radio—clip the coupon below and look their free book over. It is filled with interesting facts, figures, and photos, and the information it will give you is worth a few minutes of anybody's time. You will place yourself under no obligation—the book is free, and is gladly sent to any one who wants to know about Radio. Just address J. E. Smith, President, National Radio Institute, Dept. 22M, Washington, D. C.

**J. E. SMITH, President,
National Radio Institute,
Dept. 22M, Washington, D. C.**

Dear Mr. Smith:

Please send me your 64-page free book, printed in two colors, giving all information about the opportunities in Radio and how I can learn quickly and easily at home to take advantage of them. I understand this request places me under no obligation, and that no salesman will call on me.

Name.....

Address.....

Town.....State.....

Occupation.....



"He saves \$100 a month"

"SEE that man at the receiving teller's window? That's 'Billy' King, Sales Manager for The Browning Co. Every month he comes in and adds \$100 to his savings account.

"Three years ago he started at Browning's at \$25 a week. Married, had one child, couldn't save a cent. One day he came in here desperate—wanted to borrow a hundred dollars—wife was sick.

"I said, 'Billy, I'm going to give you something worth more than a loan—some good advice—and if you'll follow it I'll let you have the hundred too. Take up a course with the International Correspondence Schools and put in some of your evenings getting special training. The schools will do wonders for you, I know. We've got several I. C. S. men right here in the bank.'

"That very night Billy wrote to Scranton, and a few days later he had started studying at home. Why, in a few months he had doubled his salary! Next thing I knew he was put in charge of his department and two months ago they made him Sales Manager."

Employers are begging for men with ambition—men who really want to get ahead in the world and are willing to prove it by training themselves in spare time to do some one thing well.

Prove that you are that kind of man! The International Correspondence Schools are ready and anxious to help you prepare for something better if you will only make the start.

Mail the Coupon for Free Booklet

INTERNATIONAL CORRESPONDENCE SCHOOLS

"The Universal University"

Box 7694-E, Scranton, Penna.

Without cost or obligation on my part, please send me a copy of your 48-page booklet, "Who Wins and Why," and tell me how I can qualify for the position or in the subject before which I have marked an X:

BUSINESS TRAINING COURSES

- | | |
|------------------------------------------------------------------|---------------------------------------------------------------------------|
| <input type="checkbox"/> Business Management | <input type="checkbox"/> Advertising |
| <input type="checkbox"/> Industrial Management | <input type="checkbox"/> Business Correspondence |
| <input type="checkbox"/> Personnel Organization | <input type="checkbox"/> Show Card Lettering |
| <input type="checkbox"/> Traffic Management | <input type="checkbox"/> Stenography and Typing |
| <input type="checkbox"/> Banking and Finance | <input type="checkbox"/> English |
| <input type="checkbox"/> Management | <input type="checkbox"/> Civil Service |
| <input type="checkbox"/> Accountancy (incl. C.P.A.) | <input type="checkbox"/> Railway Mail Clerk |
| <input type="checkbox"/> Cost Accounting | <input type="checkbox"/> Mail Carrier |
| <input type="checkbox"/> Bookkeeping | <input type="checkbox"/> Common School Subjects |
| <input type="checkbox"/> Secretarial Work | <input type="checkbox"/> High School Subjects |
| <input type="checkbox"/> Spanish <input type="checkbox"/> French | <input type="checkbox"/> Illustrating <input type="checkbox"/> Cartooning |
| <input type="checkbox"/> Salesmanship | <input type="checkbox"/> Lumber Dealer |

TECHNICAL AND INDUSTRIAL COURSES

- | | |
|--------------------------------------------------|-----------------------------------------------------------------------------|
| <input type="checkbox"/> Architect | <input type="checkbox"/> Automobile Work |
| <input type="checkbox"/> Architectural Draftsman | <input type="checkbox"/> Airplane Engines |
| <input type="checkbox"/> Building Foreman | <input type="checkbox"/> Plumber and Steam Fitter |
| <input type="checkbox"/> Concrete Builder | <input type="checkbox"/> Plumbing Inspector |
| <input type="checkbox"/> Contractor and Builder | <input type="checkbox"/> Foreman Plumber |
| <input type="checkbox"/> Structural Draftsman | <input type="checkbox"/> Heating and Ventilation |
| <input type="checkbox"/> Structural Engineer | <input type="checkbox"/> Sheet-Metal Worker |
| <input type="checkbox"/> Electrical Engineer | <input type="checkbox"/> Steam Engineer |
| <input type="checkbox"/> Electrical Contractor | <input type="checkbox"/> Marine Engineer |
| <input type="checkbox"/> Electric Wiring | <input type="checkbox"/> Refrigeration Engineer |
| <input type="checkbox"/> Electric Lighting | <input type="checkbox"/> R. R. Positions |
| <input type="checkbox"/> Electric Car Running | <input type="checkbox"/> Highway Engineer |
| <input type="checkbox"/> Telegraph Engineer | <input type="checkbox"/> Chemistry |
| <input type="checkbox"/> Telephone Work | <input type="checkbox"/> Pharmacy |
| <input type="checkbox"/> Mechanical Engineer | <input type="checkbox"/> Mining Engineer |
| <input type="checkbox"/> Mechanical Draftsman | <input type="checkbox"/> Navigation <input type="checkbox"/> Assayer |
| <input type="checkbox"/> Machine Shop Practice | <input type="checkbox"/> Iron and Steel Worker |
| <input type="checkbox"/> Toolmaker | <input type="checkbox"/> Textile Overseer or Supt. |
| <input type="checkbox"/> Patternmaker | <input type="checkbox"/> Cotton Manufacturing |
| <input type="checkbox"/> Civil Engineer | <input type="checkbox"/> Woolen Manufacturing |
| <input type="checkbox"/> Surveying and Mapping | <input type="checkbox"/> Agriculture <input type="checkbox"/> Fruit Growing |
| <input type="checkbox"/> Bridge Engineer | <input type="checkbox"/> Poultry Farming |
| <input type="checkbox"/> Gas Engine Operating | <input type="checkbox"/> Mathematics <input type="checkbox"/> Radio |

Name.....

Street.....

Address.....

City..... State.....

Occupation.....

If you reside in Canada, send this coupon to the International Correspondence Schools Canadian, Limited, Montreal, Canada.

Salesmen and Agents Wanted

\$4 TO \$7 COMMISSION and big cash bonuses. Fastest selling line to-day direct to wearer. Real quality men's suits or overcoats only \$18.50. Dept. 20A, Preston Tailoring Company, Denver, Colorado.

SELL personal Christmas Cards, names embossed in gold. \$1 dozen up. 50% commission. Samples free. Also Box Assortments. Dunbar Corp., New Brunswick, N.J.

WE pay \$48.00 a week, furnish auto and expenses to introduce our Soap and Washing Powder. Buss-Beach Company, Dept. A48, Chippewa Falls, Wis.

TIES Pay Big! Write for big free Outfit showing ties styled on Fifth Avenue. Beautiful patterns at factory prices. \$60 weekly Easy. Berek, 4947C Hudson Boulevard, North Bergen, N. J.

\$10 to \$20 DAILY easily earned selling shoes for the largest direct to wearer concern in the world at saving of \$2 to \$3 pair; some good protected territory still open. Doublewear Shoe Co., Minneapolis, Minn.

\$2 each for names of new customers who wear an artificial eye. Send names of any you know and earn commission. Nothing to buy or sell. Denver Optic Co., 336 Quincy, Denver, Colo.

STRANGE Invention! Pays \$25 daily. Keeps telephone and iron cords from tangling and kinking. Prevents iron scorching. Saves electricity. Samples free. Neverknot, Dept. 10-F, 4503 Ravenswood, Chicago.

AGENTS. Get Vanilla Extract at one cent a bottle. Also new Black Walnut flavor. Welcome Foods, Harvey, Illinois.

LOID-LAC Amazing New Auto Refinishing Discovery. Not a Paint, Polish, Cleaner or Wax. Restores Colors and Finish to Old Cars in thirty minutes! Greatest Automotive Development in years. Make it yourself with my simple, Guaranteed Formula. Today's Fastest Money-maker. Write or wire for detailed exclusive offer. \$50,000.00 Business for \$50. Grasp today's opportunity today! Loid Miller, Industrial Chemist, Tampa Florida.

FOR Autos and Trucks "The Amber Eye" a new safety reflector prevents night accidents, reflects light from approaching car. Very efficient. Penetrates fog. Great demand, big profits for you. Sells \$2.50. Send \$1.00 for sample. Write. Hunt & Moore, New Haven, Conn.

Song Writers

SONG Poem Writers—Bona fide proposition. Hibbler, D10, 2104 N. Keystone Ave., Chicago.

SONG Writers: Let's see what you have to offer! Escher, Music Publisher, 1547 Broadway, New York City.

Stamps and Coins

STAMPS, 100. All different, 3 cents. Lists free. P. S. Quaker Stamp Co., Toledo, Ohio.

20 VARIETIES unused free. Postage 2c. P. S. Miami Stamp Co., Toledo, O.

FINEST One Cent Approvals in the United States. Stanton (144), Niantic, Conn.

STAMPS, 105 different 5c, to approval applicants. Harvey Teeple, Decatur, Indiana.

600 DIFFERENT \$50, 1100, \$1.00, 2000, \$3.50. Fred Onken, 630 79th Street, Brooklyn.

HIGH-CLASS Approvals. References Required. Pikes Peak Stamp Co., Colorado Springs, Colo.

NEWFOUNDLAND Postage Stamps. 40 standard varieties \$1.00, 16-page Catalogue free. Rev. Butler, St. Georges, Newfoundland.

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RARE United States and foreign coins, war medals and decorations. German bill and catalogue, 10c. Alexis Mengelle, Colorado Springs, Colorado.

CALIFORNIA gold, quarter size; 27c, 3/4 size; 53c. White cent and Catalogue, 10c. Norman Shultz, Salt Lake, Utah.

OLD Coins, large Fall selling catalog of coins for sale free to collectors only. Catalog quoting prices paid for coins, ten cents. William Hesslein, 101B Tremont St., Boston, Mass.

FOR finest approvals, write Standard Stamp Co., Thamesford, Ont., Canada.

200-200-200. SEND for our 200 outfit containing 200 stamps; 200 hinges; approval sheets to hold 200 stamps; perforation gauge; millimeter scale and ruler; duplicate stamp container—all for only 15c to approval applicants. Edgewood Stamp Co., Dept. 8, Milford, Conn.

Stories Wanted

BIG demand for Photoplay and Magazine Stories. We revise, develop and copyright. Sell on commission. Established 1917. Booklet free. Universal Scenario Company, 414 Western & Santa Monica Building, Hollywood, California.

Telegraphy

TELEGRAPHY—Both Morse and Wireless—taught thoroughly and quickly. Tremendous demand. Big salaries. Wonderful opportunities. Expenses low; chance to earn part. School established fifty years. Catalog free. Dodge's Institute, H374 Hart Ave., Valparaiso, Ind.

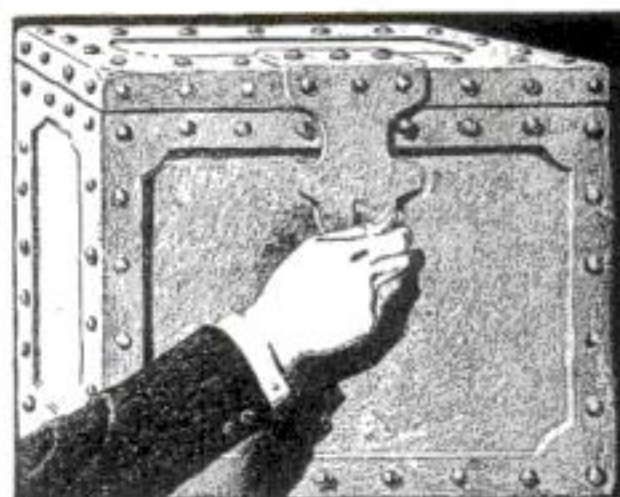
Typewriters and Supplies

TYPEWRITERS—Factory Rebuilt Royals, Remingtons, Underwoods. New Royal, Remington and Corona Portables. New "Expedigraph" Rotary Stenell Duplicator \$37.50. Terms, Catalogue Free. Pittsburgh Typewriter Supply, 543-339 Fifth Ave., Pittsburgh, Pa.

Wanted

WANTED—Live foreman or mechanic or clerk in every factory in the United States to act as subscription representative for the most popular magazine in the world. Address Manager of Representatives, Popular Science Monthly, 250 Fourth Ave., New York.

WANTED—Used correspondence school courses. Liberal prices paid. Anelys', 2353 Main, Buffalo.



Unlocking for YOU the Age-Old Secrets of Magic

Baffling secrets of the world's greatest magicians—mysteries never before divulged—supernatural effects of the Orient—massive stage illusions—the most priceless, most treasured Secrets of the Magic Profession now—for the first time—disclosed to YOU in the great Tarbell Course in Magic. Learn to perform like a real magician in a short time—in your spare time—at home. Be the life of every party—the center of every crowd, wherever you go. Business and social success are YOURS when you know Magic. And it's EASY with the Tarbell System!

Astonish Your Friends

Study the first lesson and your friends will be amazed at your wonderful Magical powers. You will have that magnetic power that gives you instant popularity in any crowd. Everyone will marvel at your apparently supernatural, psychic power. YOU possess this talent now! Surprisingly easy to bring it out. Send the coupon below now—and find out how easily you can do it.

Earn \$250 to \$1000 a Month

From Impromptu Tricks through Sleight of Hand to Great Stage Illusions—EVERYTHING is taught to you so that you can go right out and MAKE BIG MONEY WITH MAGIC. There is a tremendous demand for Magic Entertainment. Clubs, churches, schools, conventions, theaters are on the lookout for Magicians—and they pay \$25 to \$100 for perhaps half an hour's program. Keep your job and make a lot of EXTRA MONEY on the side. Just master a few easy tricks. Salesmen—business men—professional men—all can use Magic to gain popularity and profits. Easy for YOU to make \$250 to \$1000 a month!

Magic Book FREE!

Mail Coupon!

You can get this great course, endorsed by the world's greatest magicians, at a very low price. But act quickly! Write today SURE!

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Please send me your big FREE illustrated and colored booklet giving full information on the Tarbell System of Magic. Also your low prices and easy payment plan. No obligation on my part whatever.

Name.....

Address.....

City and State..... Age.....

Now

MOVIES Train YOU at Home for Bigger Pay in ELECTRICITY

*A
New, Easier
Way to a Better Job*
**Motion Pictures Make
Everything CLEAR~~~**

NOW, for the first time, an easier, quicker, surer way to make more money, by learning Electricity *at home!* Actual motion pictures—thousands of feet of film which we send you—explain every vital point in this complete course—show you how to do the work, train you for a better job and bigger pay.

By this amazing new method, you learn easily and thoroughly. Motion picture close-ups of all kinds of electrical machinery in operation, remarkable animated diagrams show you in detail the action of electrical energy. For years educators have planned to use this method, but were blocked by mechanical difficulties. Now these are overcome by our engineers.

Our films bring the great laboratories to your home. With the projector and reels which we furnish, you get *better than classroom instruction*. You can stop the film at any point—examine any picture or diagram as a "still." It's just like having one of our engineers at your side, to make everything plain. You can go over and over any point at will.

Why This Movie Way is the Easier Way To Bigger Pay

"One picture is worth 10,000 words," says an Oriental proverb. Electricity is a constantly moving force; it travels thousands of miles a second. Here, in *animated slow motion diagrams and pictures*, you see, as in no other course, how it works and is controlled.

Our instruction is real, live, fascinating. No need to fear dry text-book matter. You see and know electrical principles of lighting, power, heat, etc. You prepare yourself for the big jobs electricity offers those who know how to control its force.

Big Pay Jobs Ready for You. With the help of such practical engineers and educators as Bruce A. Rogers, M.S., Western Electric Co., J. A. Shimek, M. E., E. E. Engineer DeVry Corporation; A. P. Hollis, formerly Director Visual Education University of North Dakota; F. S. Wythe, Director Neighborhood Motion Picture School Film Service, and W. N. Littlewood, formerly instructor University of Wisconsin, who will have personal charge of your training, *you will soon be ready for big pay jobs in Aviation Electricity, Radio, Switchboard Work, Sub-Station and Power Plant Operation, Automotive Electricity, Wiring, Contracting, Merchandising, etc.*

What a Practicing Engineer Says of Our Training

Charles L. Fitz, M. E., E. E., a practicing engineer, formerly associated with Steinmetz in the General Electric laboratories, after examining this course says:

"I am amazed at how clearly and simply you explain the facts about electricity and electrical work. *You show principles in these motion pictures and animated diagrams better than we can in the laboratory.*

"The points are so much easier to grasp than by the usual methods of instruction that the student must make *quicker, surer progress*. Your whole course seems to me by far the best method of getting thorough preparation for practical electrical work."

**The NATIONAL SCHOOL of
VISUAL EDUCATION**

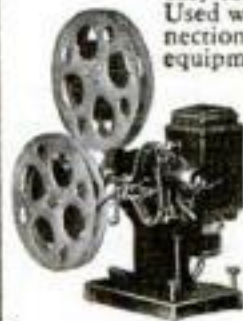
"The Film Way to Bigger Pay"

DeVry Motion Picture Projector Furnished No Extra Cost

A Standard Model DeVry School Projector for motion pictures is supplied for use in the course at no additional cost. The manufacturer prices these machines singly at \$75.

DeVry projectors are used in more schools, colleges and universities than all other makes combined. Exclusively used by Fox Film Educational Division, and Neighborhood Motion Picture Service, School Division.

The DeVry Projector is simple, easy to operate in the home. Used with ordinary light connection, or with farm lighting equipment or with automobile battery.



For the first time in any home study course, you get the advantage of methods rapidly being adopted by leading resident schools, *training you for the BETTER JOB with BIGGER PAY.*

Here's Our Promise to Help You Get a Better Job and More Money

This *new method of training* by motion pictures is practical, easy, complete, and fits you to hold down a better job. Our **Employment Department** will help you locate one of these better jobs—you receive this pledge *in writing* immediately upon enrollment.

"When you graduate from your complete Course in Electricity, you must be convinced that you have received the training and employment service necessary to obtain a better position than you now have. Or, we will refund your tuition, provided you give notice within 30 days after forwarding final examination papers."

You alone are the judge. We have to convince you that you are qualified through our training to hold down a better job—and that our Employment Service will help *get* you a better job or *refund* your money. Notice, we do not say "take a chance with our new method of training." *There is no chance.* We have to give you what we say we will, or refund your money.

Drafting Set Given We supply our students as a part of their course, not only with instruction in drafting, but also with a *complete professional drafting outfit* consisting of 18 pieces.

Three Lessons **FREE** If You Act And our New Book **FREE** NOW!

Send the coupon now and we will give you, absolutely free, three lessons, showing exactly how motion pictures are used in this training. *Get our new Book, "The Film Way to Bigger Pay in Electricity."* Fully illustrated. Shows how we train you for the bigger pay jobs. Sent Free.

Remember, action means advancement. Dreamers never arrive. Be a doer, and get what you want. Send the coupon now.

NATIONAL SCHOOL OF VISUAL EDUCATION
Dept. 10F 537 S. Dearborn St., Chicago, Ill.

Gentlemen: Without obligation to me, please send the free lessons and your book, "The Film Way to Bigger Pay in Electricity."

Name _____

St. or R. F. D. _____

City, State _____



He Chose the Way to Larger Success

How can I increase my earning power and win greater success?

That was the question Paul F. Bourscheidt asked himself, when, as Assistant Actuary of the Peoria Life Insurance Co., he first began to consider home-study business training. He answered it by enrolling with LaSalle in Business Management.

"As a result of my training," wrote Mr. Bourscheidt, eleven months later, "I notice a big improvement in my work and my ability to cope with difficult situations. Already I can report a promotion and an increase of 30 per cent, which in these days is no small item."

A year or so later, realizing the importance of legal knowledge in business, he enrolled again with LaSalle—this time for home-study training in Law. He set as his goal the Illinois Bar examinations, which he passed successfully in the fall of 1924.

Was it merely by chance, do you think, that in October of that year Mr. Bourscheidt was made Assistant Secretary and Office Manager of this great company, or that today he is being entrusted with greater and greater responsibilities?

Set Your Goal—Then Start Today

In what field do you hope to gain success? Study the coupon below—then check the training that most clearly meets your needs, enter your name, address and present position, and mail the coupon to LaSalle.

It will bring you promptly—and without obligation—an interesting book descriptive of that field, together with a copy of "Ten Years' Promotion in One," the inspiring story that has set thousands of men on the shorter route to greater earning power.

Show your will to succeed by what you do with this coupon—NOW.

— Find Yourself Through LaSalle! —

LaSalle Extension University

The World's Largest Business Training Institution

Dept. 1083-R Chicago

Gentlemen: Send without obligation to me information regarding course indicated below:

- | | |
|---------------------------------------------------------------|---------------------------------------------------------|
| <input type="checkbox"/> Business Management | <input type="checkbox"/> Modern Business Correspondence |
| <input type="checkbox"/> Modern Salesmanship | <input type="checkbox"/> Modern Foremanship |
| <input type="checkbox"/> Higher Accountancy | <input type="checkbox"/> Personnel Management |
| <input type="checkbox"/> Traffic Management | <input type="checkbox"/> Expert Bookkeeping |
| <input type="checkbox"/> Railway Station Management | <input type="checkbox"/> C. P. A. Coaching |
| <input type="checkbox"/> Law: Degree of LL. B. | <input type="checkbox"/> Business English |
| <input type="checkbox"/> Commercial Law | <input type="checkbox"/> Commercial Spanish |
| <input type="checkbox"/> Industrial Management | <input type="checkbox"/> Effective Speaking |
| <input type="checkbox"/> Factory Management | <input type="checkbox"/> Stenotypy—Stenography |
| <input type="checkbox"/> Banking and Finance | <input type="checkbox"/> Telegraphy |
| <input type="checkbox"/> Credit and Collection Correspondence | |

Name

Present Position

Address

In Spare Time at Home
He made \$85 a week with his **TENOR BANJO**

Kenneth McCarty, South Haven, Mich., never had read a note; advanced from \$15 clerk to \$85 weekly in orchestra.

Have More Money and Friends

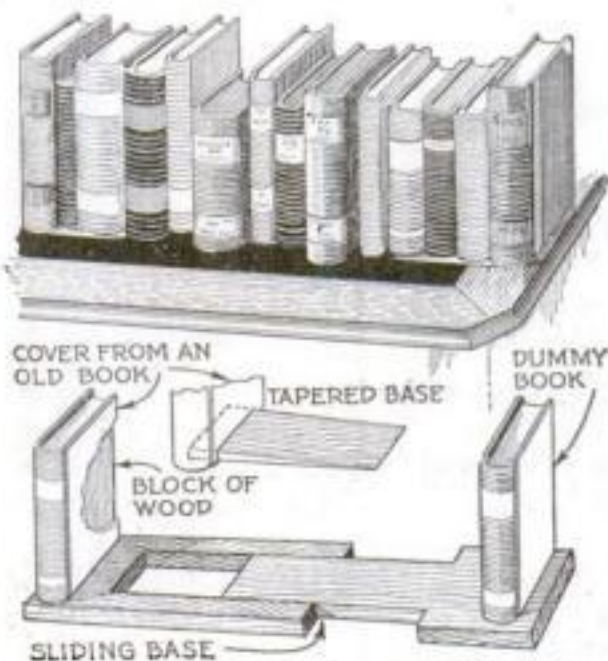
Thousands have quickly reached popularity and BIG PAY through famous "Play-Way" system of learning the Tenor Banjo right at home in spare time. YOU, TOO, can soon have more fun, friends and cash. No musical knowledge necessary. **TENOR BANJO**. Demonstration **PHONOGRAPH RECORDS** and **BIG OUTFIT** come with first lesson. Simple, fascinating and successful. **FREE** book brings all the amazing facts. Write for your copy! **NEW YORK ACADEMY OF MUSIC**
Studio 50108, 1005th Ave., New York

THIS IS McCARTY
Get this **FREE BOOK**
The Play-Way

Dummy Books Make Neat Book Ends

BOOKS placed between book ends or in a rack made as illustrated seem to be standing without visible support. That is because the end volumes are dummies glued and screwed to the base pieces.

Choose two attractive old books, preferably leather bound, of about the



Books seem to be standing without visible support when propped up by these holders.

same size—there is always a large choice of such volumes at a secondhand book store—and discard everything but the covers. Substitute wooden blocks of the correct size and shape to represent the pages and glue the covers firmly to them, keeping the lower end of the blocks flush with the lower edges of the cover boards. Finish what are to be the visible edges of the blocks with gold leaf, gold bronzing powder, or very light brown lacquer.

Make the base pieces in either of the two ways illustrated and finish them with stain and varnish or with brushing lacquer, as preferred. Then glue and screw the imitation volumes in place.—J. G.

Orange Crates Serve as Bins in Cellar Shop

ONE end of my cellar is completely outfitted with shelves divided into compartments. They were erected in less than half an hour's time and at practically no cost, because they consist of orange crates stacked one on top of the other and braced with narrow boards on each end of each tier of boxes. These upright strips are nailed to the floor joists.—G. A. W. Jr.

Tiny Saw for Model Making



Tool for cutting slots and small openings.

FOR work on ship and airplane models a small saw is frequently needed. One can be made for cutting either wood or metal from a piece of hack saw ground to a tapering point.—H. W.

Be An Auto Expert!
LEARN IN LOS ANGELES

TRAINED MEN NEEDED. Earn \$40 and up a week. If you are earning less this is your chance to gain. Auto industry will pay you more and offer greater opportunity. You qualify for Big-Pay Job through National's Famous Job-Experience Training. Over 17,000 Successful Graduates. California is Land of Opportunity. Millions being spent on autos here. Learn Mechanics, Ignition, Repairs, Construction, Garage Management, Etc. Qualify for technical or executive position or go into business for yourself. **ENTER NOW.** No Age Limit. Low Tuition. 23rd Year. Unexcelled Training. Thirty-two instructors... Free employment service while learning and after graduation. Write for Illustrated Catalog... **FREE**... Tells everything.

No Free E. S. Exam
An Honest School
Honesty Paid
Accredited by
the Automobile
Industry
Everywhere

NATIONAL AUTOMOTIVE SCHOOL

DEPT. 2029, 4006 Figueroa St., Los Angeles, Calif.

Send me the big, FREE National Auto Book that explains how I can Succeed in the Automobile Industry.

Name

Address

City

State

Age

ELECTRICAL ENGINEERING B. S. Degree

Foremost, best-equipped electrical school in America, 24 years old, offers complete practical resident course in **Commercial Electrical Engineering**—in **One Year**—Electrical Engineering—B. S. degree in 3 years. Lacking high school credits can be made up. Shorter resident courses available in **Armature Winding, Automotive Elec., Light, Heat and Power.** Also special courses to meet tremendous demand for trained men in **RADIO, BROADCASTING, ELEC. REFRIGERATION.** Recognized expert faculty. Splendid laboratory facilities.

EARN WHILE YOU LEARN!

Our employment Department will help you secure position to which you may devote a part of each day, spending the remainder at the school. Low tuition fee. Board and room reasonable. Daily Broadening WISE (formerly WSOE) School orchestra, Fraternities.

FREE CATALOG Write today for our FREE, illustrated catalog. Find out about our specialized method of training and the details of our "Earn While You Learn" plan. Mention age, education, and the course you are interested in.

SCHOOL of ENGINEERING E. Wells & Jackson
of Milwaukee Dept. P. S. M. 1028
Milwaukee, Wis.

I'll Pay You \$30 a Day! **Show my Rain Proof FITS-U Caps to Men**

I'll pay you \$30 a day to show my marvelous line of rain-proof Fits-U Caps to men! More for active workers. With my liberal commission of \$1.00 on every sale—it's a cinch to clean up \$5.00 or more an hour in spare time alone. "In two hours," writes one successful salesman, "I made \$15.70. It's the rainproof and made-to-measure features that gets the orders so quick." By a secret process, every Fits-U Cap is made **absolutely rainproof!** Rain has no effect on the Fits-U Cap. Price \$2.65—\$1.00 for real **EVERY CAP MADE TO INDIVIDUAL MEASUREMENTS!** Two other fast-selling numbers: women's hat "Lovette" and cap, tie and muffler match combination.

Don't Wait—Act Now! I'll send elaborate selling outfit to you **FREE.** Get started immediately. Just send name and address. Postal will do. **Hurry! Write today!** **FITS-U CAP CO., Dept. P-80 Cincinnati, O.**

Learn AVIATION WHERE LINDBERGH STARTED!

GET TRAINING THAT ASSURES SUCCESS!

COME to the Lincoln Airplane School—where Lindbergh started. Get the same thorough, complete instruction—now under greatly increased facilities. Here you get **practical Ground and Flying Training.** You work on real planes and motors supplied by the Lincoln Aircraft factory. You go right up into the sky in our famous Lincoln Page planes. Competent, experienced instructors. Write at once for full information!

LINCOLN AIRPLANE SCHOOL
Successors to the Lincoln Standard Aircraft School
2416 O Street, Lincoln, Nebraska



New!



Patented

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Banishes Old-Style Can Openers to the Scrap Heap and Brings Agents \$5 to \$12 in an Hour

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WOMEN universally detest the old-style can opener. Yet in practically every home cans are being opened with it, often several times a day. Imagine then, how thankfully they welcome this new method—this automatic way of doing their most distasteful job. With the wonderful little Speedo can opener you just put the can in the machine, turn the handle, and almost instantly the job is done.

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Generous Free Trial Offer

Frankly, men, I realize that the facts about this proposition as outlined briefly here may seem almost incredible to you. I'll grant you that the profit possibilities are so tremendous that it's impossible to give more than a mere hint of them here. So I've worked out a plan by which

you can examine the invention and test its profit possibilities without risking one penny of your own money.

MAIL THE COUPON TODAY

All I ask you to do is to fill out and mail the coupon below. You do not obligate yourself in any way whatever. I'll rush you the details. Get my free test offer while the territory you want is still open—I'll hold it for you while you make the test. I'll send you all the facts about \$5 to \$150 a week with Speedo. I'll also tell you about another fast selling item in the Central States line that brings you two profits on every call. All you risk is a 2c stamp—so grab your pencil and shoot me the coupon right now.

READ!

One of my prospects told me she could get along with the old can opener she had been using for years. Two weeks later her husband ordered a can opener from me saying that his wife had cut her hand badly with her old can opener.—W. L. GODSHALK, Pa.

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The author, G. E. Sterling, is Radio Inspector and Examining Officer, Radio Division, U. S. Dept. of Commerce. The book has been edited in detail by Robert S. Kruse, for five years Technical Editor of QST, the magazine of the American Radio Relay League.

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Dirigibles' New Bid to Rule the Air

(Continued from page 15)

for this loss of weight by releasing or "valving" hydrogen gas, or in the case of our *Los Angeles*, helium. The loss of this lifting gas has been more costly even than consumption of engine fuel. With the new German fuel this waste is largely eliminated.

Only three nations are competing in this realm of lighter-than-air ships—the Germans, the British, and the Americans. What are the Americans doing?

For one thing, in the *Los Angeles*, our Navy has the only training ship of its kind in the world. Uncle Sam has been busy making air sailors with specialized skill enough to fly either the new British dirigible or the new German Zeppelin to the ends of the earth and back.

AMERICA'S activities in the design and construction of dirigibles are largely centered at Akron, O., where the Goodyear-Zeppelin Company has built an organization of experts including some of the former chief assistants of Count Zeppelin. Dr. Karl Arnstein, in charge of engineering there, had a part in building about seventy German Zeppelins. Captain Ernest Lehman, vice-president of the company, directed many spectacular operations of the war-time Zeps. These two men have brought to America all that Germany learned about the construction and operation of dirigibles. The dirigibles they have projected will be produced by American factory methods, which means that once the pattern and method are worked out, they can be turned out with a speed never achieved elsewhere, even at Friedrichshafen.

What all travelers demand is the best compromise between comfort, speed, and security. One of the compelling reasons why conservative capitalists will be ready to put their fortunes into the building of immense dirigibles for transoceanic passenger carrying trade is bound up in the matter of traveling comfort. A few adventurous souls might be willing to sit cramped in the bucket seat of an airplane to cross the Atlantic in a day, but the dividends of future trans-Atlantic travel will be paid by men, women, and children who will wish no interruption of their normal bathing, dining, dancing, tooth brushing, bridge playing existence. If sometime during the next year you cross the Atlantic as a passenger in forty-eight hours or less, you will travel in a dirigible. You will be able to indulge in any of the luxuries available to passengers on ocean liners. Not even the most sanguine advocate of airplane development predicts that heavier-than-air machines can offer the same comforts for many years to come.

NONE of these arguments mean, of course, that airship development will interfere with the development of airplanes. The two modes of travel are adapted to purposes as different as the principles that govern their operation. The frenzied director of large business enterprises, the impatient lover, the individual racing with death to the bedside of a relative will use, of course, the unrivaled speed of an airplane. There will be plenty of work for airplanes in the years to come. There will be airplanes roosting on the flat tops of all dirigibles, ready to rush mails and impatient passengers over the last few hundred miles of a journey, or to fly on branch lines from the main airship routes. Just such a scheme of launching planes from mother airships is embodied in the specifications for the Navy's projected mammoth dirigibles.

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The Play That Made Football Over

(Continued from page 45)

the field its aerial game gets in full swing. Ninety-five percent of forward passes are attempted by a team beyond the fifty-yard line.

There are, of course, exceptions to every rule. I recall several instances in which I discarded customary practice and threw passes when our back was against the wall. In 1926, just as we entered Zone No. 2, I noticed that the Harvard backs were closer than they should have been for their own protection. Consequently I sent a pass about forty-five yards down the field to Myles Lane, who caught it and was downed near the Harvard goal line.

Had that pass been intercepted, it would have been equivalent to a long kick, for Lane would have dropped the Crimson man on the spot, and Harvard would be deep in its own territory. The only safe pass from dangerous territory is the long pass well down the field. If intercepted it still is as good as a kick.

TO RETURN to our quarterback, whose actions you are watching from the stand: First he feels out the opposing line with a thrust here and there, trying to find a weak spot. When he does he calls several plays through the same place, through tackle let us say, and then suddenly switches to another position.

You wonder why he changes when he is gaining through tackle. The reason is that he wants to save that weak spot until he is in scoring position; then he will send a halfback crashing for a touchdown.

Again, entering Zone 3, he may call for a forward pass, which is batted down by the defense, and you wonder why the fool ever called that play when his line plays were working to perfection. The reason is that the defending backs were beginning to move up to help hold the line. A well-placed pass tends to keep the defense in position and makes possible better gains through the line. Technically the pass failed, because it wasn't caught, but scientifically it may have made possible a big gain through tackle on the next play by depriving the defending tackle of the halfback's aid.

If the defensive backfield is drawn out of position, you can expect an early pass. And if the quarterback is calling for a play continually, you may anticipate a pass when he has got the defense out of position and off their guard.

In order to appreciate the importance of deception in a forward pass observe the moves that terminate in it. Every man runs just as he would on a line drive or an end run. Then suddenly the man carrying the ball straightens up and zips it to an end who has been scurrying down the field.

THE end must act as he would on any other play. He must take his initial charge (except on a pass requiring him to get well down the field) and dart straight for the rival halfback. The latter doesn't know whether the end is part of the interference or whether he is going to try to catch a pass. And if a pass, he still doesn't know which way the end is going to turn.

It is this uncertainty that allows the end a step's lead on the halfback, and that margin is enough to snatch a well-aimed pass out of the air.

Provided the pass is timed properly, a halfback has little chance of intercepting it. An intercepted pass is generally the result of a bad throw or ill timing—and timing is simply the art of getting the ball to a certain point just as the runner arrives there. In all sports, timing is important. In the forward pass it is vital.

When a team is in Zone 5, the wise quarterback will not call for passes over the goal line into the end zone, because when the ball is thrown or kicked over the goal line it is a "touchback," and the ball goes to the defending team on its twenty-yard line. That is why you will see so many flat, bulletlike passes when a team is approaching the opponent's goal. This type of pass has its dangers, though. If intercepted it usually means a touchdown for the man who caught it, since he has a clear field to the other goal. The man who passes the flat pass is expected to protect it by running out in the same direction; but often he arrives too late.

Forward passing on the last down is foolhardy because if the pass is incomplete the opposing team gets the ball at the point where it was put in play, and consequently the offending team has lost all the distance it would have gained by a kick.

A smart quarterback will blend his running attack harmoniously with his passing attack so that the defending team is in a perpetual quandary as to what to expect. Knute Rockne, Jesse Hawley, and "Chick" Meehan build their plays with an intelligence and subtlety that keep the opposing teams continually guessing.

Nothing else has had such a tremendous and invigorating effect on football as the forward pass. It opened up the play and elevated the game from the gruesome battle of the old "push-and-pull" era into a scientific pastime. Once the successful team was that which possessed the most strength and weight; now it is the team that combines scientifically a strong running attack with a well executed aerial game.

And nothing quite so thrills the football multitudes as does the colorful pass. With it games have been pulled out of the fire, defeat turned into victory.

Every year teams come over the football horizon that are exceptional in the use of the forward pass. Dartmouth, Notre Dame, and California have shown what can be done with the forward pass. Georgia, too, and many others have had their great aerial teams.

Who will it be this year that forward-passes its way to gridiron glory?

Science Slashes Coal Bills

HOW would you like to cut next winter's coal bill nineteen percent, and still have your house as warm as you need it? L. C. Price, research engineer of the University of Arkansas, says tests have shown that the saving can be accomplished simply by cutting down the grate surface of the furnace in mild weather, when less heat is needed. Experiments in various climates showed that the saving ranged from thirteen percent in Chicago to thirty-five in New Orleans.

At a recent meeting of the American Society of Mechanical Engineers a score of new designs of high pressure boilers were described which effect important fuel economies. Whereas the ordinary power boiler generates steam at about 200 pounds pressure, some of the new designs operate at 2,000 pounds and more. Forty power plants now use boilers of more than 500 pounds pressure.

Last year, according to Department of Commerce figures, the world developed sources of power—in coal, oil, and water power—equivalent to nearly 2,000,000,000 tons of coal. Only about three percent of the world's resources in hydroelectric power are now being put to use, though from 1920 to 1926 there was an increase in developed water power of 10,000,000 horsepower.

Secrets of New Color Movies

(Continued from page 18)

rib on the film only focuses the lens of the camera crosswise of the film. If the filter were installed so that the divisions between the colors were horizontal instead of vertical you would see no color effect at all; the curved surface of the celluloid rib could not focus in that direction.

Now suppose that the camera were pointed at a red object—a red apple, for instance. Light from the apple would strike every part of the lens, but it would pass through only the section covered by the red filter. The celluloid ribs that happened to be at the points where rays of light from the apple struck the film would promptly photograph on the sensitive emulsion spots corresponding to the side of the lens through which the light was coming. The rest of the lens would photograph black because no red light could get through the green and blue filters.

WHEN the film went through the finishing process, the spots where the red light struck would be transparent, while the spots where the blue and green sections of the lens were focused by the curved surface of the rib would be black because no light had struck them.

Then, if you placed the film in the projector and turned on the light, rays would go through the transparent spots and the curved surfaces would shoot them at the section of the lens that was covered by the red part of the filter. The white light rays would go through the lens and when they hit the filter all of them would be absorbed but the red. These would go to the screen and appear in actual color.

Exactly the same process would be gone through if the object were green or blue. Each color would be registered at different points in a crosswise direction under the ribs and would be projected after the film was finished, through the same sections of the lens that threw the original rays on the sensitive emulsion.

Obviously the taking filter and the projecting filter have to occupy the same relative positions in front of the camera lens and the projecting lens respectively. If one were reversed, the center color still would be correctly projected, but the outside colors would be reversed so that red objects would appear blue, and vice versa.

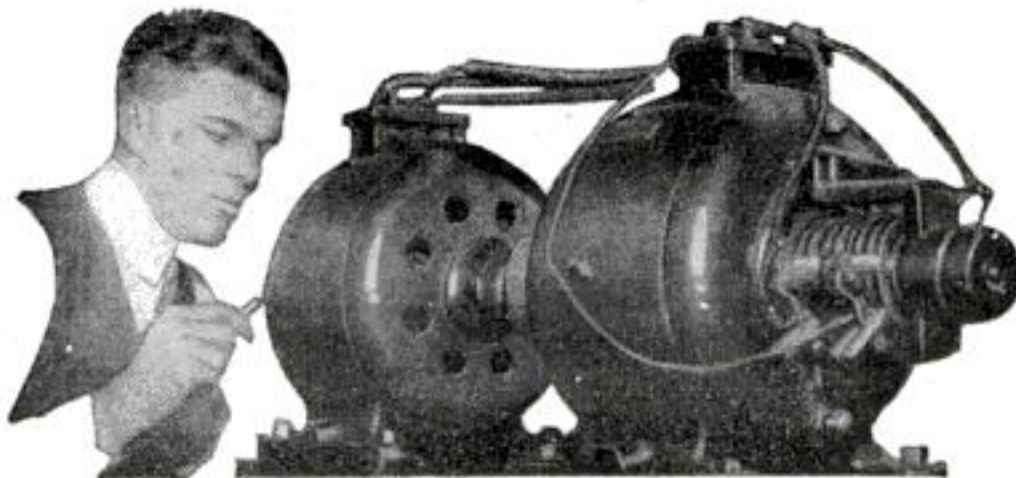
Of course when a white object is photographed, the curved surfaces of the ribs will register all three colors side by side on the film. The projector will, in turn, project light through all three sections of the lens and the object will appear white on the screen.

OBJECTS of other colors than white, red, green or blue also are reproduced in exactly the right shades on the screen because every known color can, as far as the human eye is concerned, be made up of some combination of red, green, and blue. A vivid purple object would, for instance, send light through both the red and blue sections of the filter screen to register on the film, and the corresponding light projected through the same sections to the screen would appear to the eye as a vivid purple.

Remember that all pictures are made up of countless points of light and you will realize how these minutely small specks of color can make your eye believe that you are seeing a complete picture in full colors.

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AN ORDINARY blotter, steeped several times in a solution of oxalic acid or potassium oxalate and dried, will very effectually erase ink. Apply it while the ink is still moist; or, in case the writing has dried, moisten the blotter a trifle.



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On Time in the Fog

(Continued from page 36)

the old fellow watching the speed recording dial. Marley's eyes sought the speed clock, found the needle trembling at sixty. His heavy foot kept time with the wheels clicking over alternating rail joints.

An exclamation from Old Bill caused Marley to turn his head sharply. The engineer was pushing the throttle forward and manipulating the air valve. The deck of the big Pacific shuddered as the brakes took hold and the impact of the heavy steel train jarred the tender, tumbling lumps of coal against the coal gate.

Marley had seen the red light in front of the engineer's seat and knew what was causing Old Bill to stop, but not until he saw the gleaming green eye upon a roadside signal mast did he know he had encountered his first false stop.

He sprang from his seat with a yell.

"False stop, Bill. Those devils at the test loop will pay me for this. Find the trouble, Ed."

THE mail ground to a noisy stop. One long and three short whistle blasts told the flagman to go back a quarter of a mile with red signals and track torpedoes to stop any following train. The helper began tracing the course of the electric wiring with a screw driver. Suddenly the red light blinked out and a green reappeared in the cab.

Marley yelped for Old Bill and reached for the whistle lever to recall the flagman. The 5019 worked steam and rumbled westward into the night. The speed climbed to fifty miles an hour and once more the cab light changed from green to red. Old Bill, with head and shoulders projecting from the cab window, was so intent upon the roadside signals that he did not observe the change of lights upon his instrument board. Marley opened his mouth to call to the engineer, but closed it without uttering a word. The speed at the moment of the signal change was almost sixty miles an hour. Marley estimated this would give Old Bill about six seconds to act if he would forestall the action of the automatic engineer. Came then, without visible cause, the hiss of air brakes and the grind of brake shoes upon engine and car wheels.

The mail ground to a stop with Old Bill gazing in empty-handed astonishment at the brake valve he had not touched. Marley paid no attention to the bewildered engineer.

"WELL, is this a peek-a-boo system we have, or is it some street signals?" he demanded of Ed who was examining the gages.

"Insulation burnt off drop cord," Ed exhibited the exposed wires to the irate superintendent. "When it touches the gage bracket it short-circuits."

Ed taped the cord and the train moved on. Marley was silent for several miles. Then he began an investigation after the usual Marley fashion, that of causing the witness to believe that the crime belonged to him.

"What burnt that insulation?" he rasped in Ed's ear.

"Suppose a torch."

"Why did you do it, lad?" Marley snapped.

"I didn't, Mr. Marley."

"Then who did it?"

The helper was silent.

"You won't tell me who plays the dirty trick on Old Bill?" he demanded coldly.

"No, sir, I told you I didn't do it."

"All right, lad," Marley laid a fatherly hand upon the young man's shoulder, "I was just wantin' to know what kind of a boy you was. But I'll find out who did it, an' when I do—"

They were stop-

(Continued on page 155)



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On Time in the Fog

(Continued from page 154)

ping again, with Old Bill manipulating the air brakes. It was the same false condition; the cab light showing red while the roadside signal, which it was supposed to repeat, gleamed a perfect green.

The superintendent followed Ed to the front of the engine and stood by impatiently while the helper examined the coils contained in an aluminum housing just ahead of the pony truck wheels. Whatever repairs were made to the apparatus could not be described by Marley. The important item was that Ed seemed able to put his screw driver into the seat of the trouble without excessive delay. A shout from the fireman called the crew into the cab. The mail moved on.

Four additional stops were made within the next hour, and at each of them Marley cursed aimlessly while the helper tightened electrical contacts and removed foreign substance from between generator brush and brush holder.

"HOW could she test O. K. at the loop an' still be in this condition?" Marley snapped at Ed when they were under way after the last stop.

"Fast running will shake things loose, break contacts that won't show up at slow speed," Ed explained.

"But tell me, lad," Marley urged, "is the train control system so flimsy that it can't stand a few shocks?"

"No, it's of very rugged construction, Mr. Marley. It's got to be properly adjusted and maintained to stand the gaff of speed."

"But it's not standin' the gaff; an' we haven't got the speed above sixty miles an hour yet," Marley objected.

"No, and we won't get above sixty. The system is set for sixty; that's as high as we can go."

"What?" Marley shrilled. "You mean to say we can't run faster than sixty miles an hour, an' us more than an hour late now?"

"That's what I mean, Mr. Marley," Ed admitted. "We can try to run faster, but before the speed reaches sixty-one, the brake acts automatically, independent of the engineer, like it did back there when he wasn't looking."

Marley studied his time-table and watch.

"You think we've found all the troubles which that gang of high-binders is goin' to answer to me for?" he asked.

"Yes, sir, I don't look for any further trouble."

"WHO ordered the speed governor set for sixty?"

"Why, I think you did, Mr. Marley," Ed replied.

"If I said seventy now, could it be changed?"

"Well, it might, but I don't know that I could set it exactly at seventy. Anyway, that'd be cheating. It's a kind of trade secret, the manipulating of—"

"You could take the bridle off entirely?" Marley suggested.

"Yes, sir, but—"

Marley was silent. The mail flashed through Mill Ridge. Listlessly the superintendent consulted watch and time-table, then lurched across the gangway to Old Bill's side.

"Sixty miles an hour from here on in means—" he stopped and looked appealingly at the engineer.

"It means we're goin' in late, boss," Old Bill's lips trembled.

"Of course those delays will explain—"

"They won't explain nothin' to me, boss," Old Bill interrupted, "nothin' except I went in late on my last trip. I wish now I hadn't come. Had a

(Continued on page 160)



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On Time in the Fog

(Continued from page 155)

hunch comin' east last trip I ought to lay off, not chance it."

The train rumbled to a stop at a water tank. Old Bill slid out of the gangway, oilcan in hand.

Marley jerked his thumb in the direction of the speed governor. "His last trip, Ed," he begged, "we can't let him go in late. Take her bridle off."

Through the cab window Marley watched the helper poking his screw driver into the delicate mechanism that automatically controlled the speed limit.

The fireman shoved the tank spout to clear and called; "All right!" Old Bill climbed wearily into the cab for the last time and started the train.

FOR a few miles not a word was spoken as the needle on the speed dial hovered around sixty. Marley was lost in a problem of railroad mathematics as, with watch and grimy time-table, he essayed to find the answer to something which meant as much to him as it did to the veteran at the throttle. The problem, when sifted of sentiment, was: how fast must they travel to finish the remaining hundred miles in an hour and fifteen minutes? When he found the answer he lurched across the deck and gave the order.

"Haul the mail, Bill," he yelled, "the bridle's off!"

"Off!" Old Bill eyed him hopefully, "you mean I can get this jack above sixty per?"

"Sure, if you ain't afraid to run her!" Marley shouted.

"Afraid to run 'er!" Old Bill widened on the throttle. "Say, boss, you remember that night we pulled the President out of St. Louis? Night kind o' like this, too, only it was foggy all the way. Lordy, it's thick enough now, though."

For a brief instant Marley did not catch the significance of Old Bill's chatter, not until the engineer pointed ahead.

When Marley saw what Old Bill meant he returned to his place on the fireman's seatbox and peered into a fog so dense that the rays of the powerful headlight appeared to collide with the stuff and scatter it ahead of the speeding train.

"Ain't it a lovely night!" Old Bill cackled as with deft hand he felt with lever for the notch best suited for the speed they were making.

"FORGET the fog, Bill," Marley yelled. "Give us some of that stuff you're always braggin' about round the test loop. We got train control now; we don't have to see the roadside signals. Those cab signals tell you if anything's ahead in the fog."

"Hell, who's talkin' about fog!" Old Bill bellowed above the noise of the pounding engine.

There is no mechanical sound quite so pleasing to the ear of an engineman as the quick staccato bark of a free-steaming locomotive at high speed. From sixty-five miles an hour, the needle climbed to sixty-eight before Marley had time to do more than mutter his satisfaction at having brought Ed with him. Sixty-nine, seventy, seventy-five. The bark of the 5019 came faster and Marley surrendered himself to the thrill of the hour. The deep voice of the big Pacific rose and swelled as mile after mile of swirling fog streamed along. Eighty miles an hour. The needle trembled. Eighty-five. The voice of the big Pacific changed into a kind of drumming ha ha ha ha ha ha, like a never-ending peal of metallic laughter. Ninety. Ninety miles an hour! The sound from the stack was that of the far-flung drone of a powerful motor, and at ninety miles an hour the sensation of the men in

(Continued on page 157)

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On Time in the Fog

(Continued from page 156)

the engine cab changed from speed to flight. The pounding roar from the rushing track underneath, the clang of fire door and scoop at the hand of a hard driven fireman, the steady drum from the smoke-blackened stack, blended into a single voice, the voice of a locomotive hauling the mail.

Marley's hands were stiff from clutching the seatbox, but he had no thought for his discomfort. The helper huddled at his side and stared wide-eyed into the fog. Marley glanced across the cab, and what he saw there touched him as nothing else could do. He saw the veteran engineer who was nearing his last terminal; saw the old fellow standing erect in the cab with his cap hitched low to meet his dust goggles, saw his clean-shaven railroad jaw set in forward motion as was his engine lever. Lost to his surroundings, oblivious of everything except the mighty thrill that comes only to the engineer who believes he can reach his terminal on time.

"We're flyin', Bill!" Marley shouted into the roar, "An' you wishin' a while back you'd stayed home!"

Old Bill grinned.

The mail train clattered over Kaw Bridge and slipped into the station on time. Marley stood up and delivered a speech to his audience of three grimy men.

"Set the speed governor back to sixty, Ed," he commanded, "and don't let me ever hear of you tamperin' with things you know nothin' about. You'll have breakfast with me in my car, with Bill Stone, a hoghead if there ever was one, an' the young buck who makes steam enough for Lindbergh, he's comin' along. It's a fine night's work you've done, boys, so now we'll wreck a dozen eggs and a string of flats."

Four men slid out of the gangway of the big Pacific and hurried toward Marley's private car at the end of the train.

Radio Gyps Exposed

(Continued from page 40)

than a single fifty-foot strand of wire.

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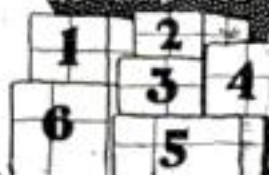


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Answers to Aviation Questions on Page 48

1. Louis Blériot, July 25, 1909.
2. Lighter-than-air.
3. The United States of America.
4. By pulling a ring attached to the "rip cord."
5. More miles per gallon can be obtained from a light airplane.
6. A radio sending apparatus giving out signals for the guidance of aircraft.
7. No. It has been used successfully with all cylinder arrangements.
8. For a given cruising radius the economical engine will require less fuel so that a greater pay load can be carried.
9. From 900 to 3,000 revolutions per minute, the usual rate being around 1,800.
10. No.
11. A building to house an airplane.
12. The N. C. 4.
13. 266.59 miles an hour, Lieutenant A. J. Williams.
14. Four to ten hours.
15. A mechanical mixture of gases, principally nitrogen and oxygen.
16. Density becomes less with altitude.
17. Air resistance varies as the square of the speed.
18. A body shaped to offer low resistance to a moving stream.
19. A tunnel in which an air stream is driven past a model to be tested.
20. Less.
21. Eighty miles an hour.
22. The stream of air driven astern by the propeller.
23. No.
24. When, if disturbed, it returns of itself to a normal flight attitude.
25. A nose-first descent with the machine rotating about a vertical axis.
26. Sliding sideways, away from the center of curvature, when turning. Opposite of the side slip.
27. When it has lost the air speed necessary for control.
28. A landing in which the wheels and tail skid touch the ground simultaneously.
29. Yes.
30. A turn in which the wings are straight up and down.
31. An aircraft, heavier than air, whose chief support in the air is derived from the vertical thrust of an air screw.
32. An airplane designed to rise from and alight on either land or water.
33. Less wing spread and easier to design as a light, strong structure.
34. The tail surfaces, including stabilizer, fin, rudder, and elevator.
35. A controllable vertical tail surface to give directional control.
36. A pusher has the propeller in the rear of the wings, the tractor, in front.
37. A monoplane with no external wing bracing.
38. The part that supports the rear of the airplane when on the ground.
39. Steel and duralumin.
40. Aluminum and copper.
41. Spruce.
42. To tighten the cloth, make it air-tight, and to preserve the cloth.
43. On account of its more uniform quality and dependability.
44. Hard to maneuver on the ground.
45. A shock absorber strut in the landing gear in which a plunger moves against oil resistance in a cylinder.
46. A controllable horizontal tail surface to give longitudinal control.

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A definite program for getting ahead financially will be found on page four of this issue.

A Mystery of the Blood Solved

(Continued from page 27)

Young Harvey, however, observed that the valves were present also in the veins extending upward to the head. Here the explanation would not hold. What was the answer? He determined to find it, and this determination led to his revolutionary discovery.

Returning to London with the degree of Doctor of Physic, we find him, at the age of twenty-four, beginning the practice of medicine and setting apart a room in his house as an experimental laboratory. Here he dissected all sorts of animals, examining them as best he could with a simple lens—for the compound microscope was not yet known. And he found that the valves always closed instantly against outward flow of blood.

Next he experimented on himself, tying a tourniquet about the upper part of his arm until the veins swelled and trying to massage the blood outward to the hand. The blood could not be forced past the valves. At last he demonstrated to his own satisfaction that the valves would let the blood in the veins flow in only one direction, inward toward the heart. The veins could not possibly be canals to carry blood outward from the liver as Fabricius had taught. What, then, was their purpose? Seeking the answer, he devoted fourteen more years to study.

Meanwhile, his reputation as a physician grew. In 1616 we find him lecturing on anatomy before the College of Physicians, and intimating for the first time that he was near a great discovery.

"It is demonstrated," he said, "that the perpetual movement of the blood in a circle is brought about by the beat of the heart."

Two years later he was appointed Physician Extraordinary to King James I. But it was not until 1628, while he was physician to King Charles I, that Harvey gave the world his completed discovery in a book labeled "An anatomical treatise on the movement of the heart and blood in animals."

WITH concise, definite proofs he completely overturned prevailing "notions." He revealed the heart as a double force pump more intricate than any designed by man, sending out, through the arteries, blood laden with nutriment and oxygen for the living tissues. This blood, having discharged its supply of fuel, took on a load of waste products, entered the veins, and passed through the organs of excretion, where the waste was discharged, and then back to the heart.

Entering the pump on the right side of the heart (the right auricle and ventricle) it was forced by way of an artery through the lungs. Receiving there a fresh supply of oxygen, and discharging waste carbon dioxide, it returned to the left-hand pump (the left auricle and ventricle) and was sent out through arteries to the organs and tissues, repeating the round trip.

Harvey never was able to demonstrate exactly how the blood passed from the arteries to the veins. He had not the microscope which, four years after his death, revealed the narrow pathways—the capillaries—through which the red blood corpuscles pass single file to deliver their nourishment to the tissues.

His great work paved the way for this and other amazing discoveries which have followed—how microscopic red disks in the blood keep us supplied with food and fuel; how an army of white corpuscles in the blood stream fight off invading enemies of disease; how tiny chemical messengers—the hormones—speed from the glands of internal secretion through the blood stream to keep our bodies in running order. In short, it is to Harvey that we largely owe our present conception of the body as a machine, made up of thousands of millions of living units, all working together.

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Windows, the Eyes of the House

(Continued from page 32)

also heavier varieties termed 26-ounce, 29-ounce, 34-ounce heavy and 39-ounce heavy, the figures indicating the average weight per square foot. The last named is about $\frac{1}{2}$ -inch thick. The largest dimensions recommended for single strength glass are 40x50 inches and for double strength 60x80, while heavy sheets may be larger. These are liberal estimates.

What is plate glass?

Glass that is made by pouring the melted material on a metal table and flattening it with a massive roller. It is then annealed, ground to uniform thickness and polished to a lustre. The extra cost of the process and also the usual greater thickness of plate glass explain its higher cost. Since the surfaces on both sides are true planes, plate affords perfect vision without distortion. Somewhat recently a lighter plate, which is $\frac{1}{8}$ inch thick and weighs about 26 ounces per square foot, has been developed for houses. It will fit in the ordinary sash, needs no extra counterweight, and does not cost much more than ordinary glass.

Does plate glass require special attention?

Before installing, the sheets should be kept on edge with paper between to prevent scratching. Any rough treatment or dirt may affect the polished surface. Allow for contraction and expansion in large sections of it. In mirrors and wainscoting, ventilation space behind the glass is advised. Ammonia and other alkalis attack the polished surface of plate glass and therefore should not be used in cleaning.

IS IT true that some unclear glass lets more light through than clear glass?

Yes, although the average person finds it hard to believe, even when it is all explained. The scientists who have made painstaking experiments assure us that some glass you can't look through transmits three to fifteen times as much light as the most perfect pane of clear glass. The glass of superior luminosity has a surface made up of ribs, ripples, prisms, rounded protuberances or the like. These act as lenses, seizing at every angle rays of light that would otherwise miss the window opening and directing them through the glass.

Is such glass desirable for houses?

It is excellent for bathroom windows, adding light and saving curtains. It can be used to advantage to obtain privacy and more light when a dwelling is closely flanked by a house on each side. Again, the average basement could be better lighted with this type of glass.

Is ground or colored glass of any value?

Neither adds to illumination, but the first softens the glare of sunlight and the second is ornamental. A prismatic or similar surface in colored glass may compensate for illumination loss due to color and yield as much or more light than a clear pane.

What about ultra-violet ray glass?

It is a special composition that embodies some of the properties of pure quartz in transmitting the upper rays of the daylight spectrum which are stopped by all other glass. These rays promote growth and health; are germicidal and life-giving, protect against rickets in children, and hasten the recovery of invalids. People who spend enough time outdoors get plenty of the beneficial rays direct from the sun, but others, those confined indoors, may benefit by this glass.

Does a window of this kind let in more light?

Yes, but not that you can see, because the added rays are invisible. The glass generally looks the same as an ordinary pane and has about the same thickness. It is distinguishable only by the maker's label or trademark etched in one corner of the pane.

What is the cost of ultra-violet ray glass?

From about fifty cents to five dollars a square foot. Since the difference cannot be due to style or weight, it is fair to assume that relative efficiency and permanence are the factors involved.



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Here Are Correct Answers to Questions on Page 66

1. This was a custom of the Indians of the northeastern United States, especially of those highly organized and quite civilized tribes who lived in what now is New York State and who are remembered as the "Five Nations." Under the name of "wampum," seashells, bored with holes so that they could be strung into strings or woven into belts, were used in place of money.

2. This name comes from an ancient Greek word meaning "wanderers." In several parts of the world, especially in Asia Minor, Arabia, and Persia, there are tribes of people who migrate twice each year in order to find food and proper climatic conditions for their herds of sheep and cattle. They have no settled homes. These people are called "nomads."

3. In the islands of New Zealand. New Zealand contains a great many geysers, hot springs, and other evidences of recent but expiring volcanic activity. In primitive times the natives cooked food by placing earthenware vessels in the springs. Nowadays they use tin or granite-ware pots.

4. This curious rule is made by the priests who control the sacred island of Miyajima in the Inland Sea of Japan, west of Osaka. This island is sacred to three goddesses of the Shinto faith, one of the prominent religions of Japan.

5. These are undoubtedly the famous mines of Kimberley in the Union of South Africa. At Kimberley there exist great "pipes" or rounded columns of a special variety of rock, in which the diamonds are found. This rock is dug out of great pits, allowed to lie on the surface until it becomes soft, and then is crushed for the recovery of the precious gems.

6. The deepest canyon in the world, as well as the longest, is the Grand Canyon of the Colorado River. In places this great gorge is more than a mile deep. A view from an airplane is one of the most spectacular sights imaginable.

7. An iceberg is the product of a glacier. The icebergs that infest the North Atlantic and that are so dangerous to steamer traffic, come mainly from the coast of Greenland. Northern and central Greenland are covered with a vast sheet of ice. From this sheet, the rivers of ice, the glaciers, flow slowly down to the sea. In the bays and fjords of the west coast of Greenland great pieces break off and float away. These are the icebergs.

8. The Caribbean Sea, especially south of Haiti and Porto Rico, is subject to a kind of severe storm that mariners call a hurricane. Hurricanes are not usually accompanied by twisting, like tornadoes, but are characterized merely by an extreme violence of the wind. The name hurricane is taken from the ancient Carib-Indian name for the storm god worshipped by these primitive people.

9. This probably is the mining town of Cerro de Pasco in the central part of Peru. This town is more than 14,000 feet above sea level, nearly three miles.

10. This distinction is believed to belong to Panama City, at the Pacific end of the Panama Canal, founded by the Spaniards in 1519.

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Electric "Suns" Fight Disease

(Continued from page 33)

rays of sunlight are absent or dim and little time is spent out of doors. Then, if ever, are ultra-violet lamps needed.

These lamps are powerful. Even natural sunlight may be venomous, as anyone who has been severely sunburned knows. The ultra-violet lamps, or most of them, emit more powerful rays, for persons close to them, than the rays of sunlight. The excuse for their use in spite of these dangers, is that they really do many human beings much good.

Physicians have proved, for example, that ultra-violet rays help prevent and cure the children's bone disease called rickets. They frequently stop falling hair and when used with extreme care by skilful physicians they can sometimes kill germs and cure disease.

ONE of the most serious of all diseases is tuberculosis of the bones and for twenty years Dr. August Rollier has been curing this disease at the mountain town of Leysin, in Switzerland, by careful exposure to natural sunlight. There child sufferers play games and recite their school lessons in the snow, wearing almost no clothes. In Paris, Madame David-Weill has for several years conducted schools in which the pupils are kept out of doors for the benefits of natural sunlight. For a generation a few physicians have been pioneering in such uses of the rays from both natural sunlight and lamps.

Home use of these lamps to cure disease should never be attempted except under a physician's direction. The important thing for laymen is that they may help prevent disease. Perhaps their usefulness in this is not absolutely proved, for scientific work with them is very new, but there is strong reason to believe that regular exposure to mild ultra-violet rays is a useful health precaution, like good food, fresh air or plenty of sleep.

Two quite different kinds of "artificial sunlight" lamps are now on sale. In one type the ultra-violet rays, with ordinary light rays, are generated by passing electricity through a vapor of mercury inside a tube of fused rock crystal, technically called quartz. These lamps are the so-called mercury arcs. The lamps of the other type are arc lamps in which an electric arc plays through the air between two rods of carbon or metal. The mercury arc lamps are more powerful in ultra-violet rays, but either type is powerful enough. Prices, devices for safe and convenient use and other features differ widely among the numerous commercial varieties.

UNFORTUNATELY, there are also on the market some so-called sunlight lamps which give no ultra-violet rays. One of these was brought into my laboratory recently by an acquaintance who had used it for months on his wife and children without any perceptible effect. Simple laboratory tests showed not a scintilla of ultra-violet rays. An ordinary electric lamp bulb would have been just as useful.

The visible light which one of these lamps may give out tells you nothing of the amount of invisible ultra-violet rays it emits. To test the production of real ultra-violet rays all that is necessary is a piece of ordinary window glass and a strip of the photographic paper called "printing out" paper, on which a visible image slowly appears when the paper is exposed to light under a photographic negative.

Ultra-violet rays darken such printing out paper far more rapidly than do ordinary light rays. Also, window glass is opaque to ultra-violet rays, although transparent to visible light rays. Hold the glass on top of the photographic paper, so that part of the paper is covered and part exposed freely to the rays.

After a few moments' exposure, if the exposed part of the

(Continued on page 163)

Electric "Suns" Fight Disease

(Continued from page 162)

paper is much darker than the part protected by the glass, there are ultra-violet rays present. If the covered part is only a little darker, little or no ultra-violet radiation is being emitted.

For the safe use of the ultra-violet rays at home there are equally simple rules, which will prevent burns or other injuries.

Start by exposing only the upper part of the back or the chest for not over two minutes, placing the lamp six feet away. If this mild dose causes severe reddening of the skin then you are especially sensitive to the ultra-violet rays. For you they are virtual poison. Don't use them. Even strong sunlight will be dangerous for you.

ON MOST people this short exposure of a little skin shows no perceptible effect. In this case increase the amount of skin exposed little by little and lengthen the time of exposure by about a quarter of a minute a day until you notice that the skin is slowly being tanned, as if by natural sunburn. Then continue that same daily exposure. It is neither necessary nor wise to use strong rays that redden the skin like sunburn. If this happens, shorten the exposure. But gradually expose more and more of the skin until the whole body receives the rays; one full exposure on the front, another equal exposure on the back.

Never stand nearer the lamp than six feet. Close and long exposures, causing subsequent reddening of the skin, may be necessary when prescribed by a physician. They should never be taken otherwise.

Nervousness and sleeplessness are signs, among other things, of too much ultra-violet rays. If these symptoms appear, stop the rays until you can consult a physician.

When using the rays always wear goggles completely covering the eyes, like dust goggles with dark glasses. Even weak ultra-violet rays may be very harmful to the eyes.

Dynamic Radio Speaker

(Continued from page 43)

producing the wave of rarefied air that alternates with the wave of compression to form the complete sound wave, just as the waves in the ocean are separated by the hollows in between.

When no baffle board is used these out-of-phase waves meet at the edge of the cone and neutralize each other. The baffle board serves to keep them apart until they have transmitted their motion to the surrounding air. The effect is much more pronounced on the low notes because the corresponding air waves are so much longer. For practical results the baffle board should extend at least two feet in every direction from the edge of the cone. Whether it is round or square is of no importance.

At first glance it would seem that the same result could be accomplished by inclosing the speaker in a small box so that the waves from the back of the cone would be completely muffled. However, this method cannot be used because the closed box would act as a damper and interfere with the free vibration of the cone. Dynamic cone speakers can be obtained either in the unit form or mounted in cabinets which are so constructed that they give the baffle board effect.

The only disadvantage of the dynamic cone type speaker is that it requires a supply of direct current to operate the electromagnet.

The battery set owner can obtain this current from his regular A-battery. The owner of a full electric receiver will have to purchase a special type of dynamic speaker unit that includes a built-in rectifier unit that operates from the electric light socket. Such a unit is shown in the illustration on page forty-three.

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They're Farming the Ocean Now

(Continued from page 38)

assure us that agriculture is a comparatively new human activity; men hunted before they planted. Then they discovered that breeding and raising animals was better than hunting. Inevitably, though, the day is coming when the seas will be planted and their crops gathered month in and month out without regard to the brief seasons that rule the activities of the land farmer.

The land farmer can measure his acres only by surface dimensions, but the seventy-one percent of the earth's surface that is covered by the oceans is a garden more than a thousand feet deep, the depth to which sunlight penetrates and enables plant life to survive, thus providing sustenance for animal life.

Most of the green plants of the ocean are of microscopic size but a scientist, Dr. W. R. G. Atkins, calculates that in the English Channel alone there is produced every year the equivalent of 12,000 pounds of plant life to each surface acre. In each cubic foot of sea water he counted millions of plants, the grass of the ocean pastures. Some whales attain their bulk by straining from the water the tiniest creatures that in turn have fed on that microscopic green plant life, and that is the swiftest transformation that men have encountered in the sea. Other ocean creatures, of which scientists have examined and labeled more than 19,000 varieties, participate in a more deliberate cycle. Diatoms, microscopic creatures which reproduce by dividing their own bodies into halves, are meat for sea fleas, which are swept into the bellies of larger fish that are in turn devoured by still larger creatures.

HELD in the 302 millions of cubic miles of water of the oceans are vastly greater riches than are contained in the thin veins of our mineral mines on land. There is gold in immeasurable quantities if it could be recovered. More important, though, are the millions of tons of iodine held in solution there. Certain weeds of the sea, called tanglers, extract that iodine from the water in a form in which it can be recovered by men. Seaweed burning is an ancient industry. The seacoast people of Britain, France, Norway, Japan, and certain portions of our own coast, reap this plant from the rocks where it grows. They are called kelp burners. The methods are crude and scientists are hoping to discover somewhere for ocean farmers of the future a richer source of iodine than the weeds that grow along shore. They know it exists, because there is iodine in beneficial quantities in the flesh of every salt water fish that comes to your table.

The traveler who crosses the great central plains of the United States with seemingly endless fields of corn—eight miles of furrow to every acre—views a phenomenon that contains a hint of what ocean farming of the future will be. Only an average of fifteen percent of that corn reaches the great grain elevators at Chicago, Omaha, and Kansas City. The bulk of it is fed to swine and cattle, from which comes food, leather, medicinal products, and other materials for the use of man. So it will be with ocean farming.

BEFORE the Western farmer planted corn and wheat, ranchers grazed vast herds on the plains, and before them, men hunted buffalo and antelope. In like fashion the whale was hunted almost to the point of extermination, American whaling ships once numbering more than seven hundred. Whales are growing scarcer now that shore factories have replaced the try-pots of the whaler's deck, but just as men replaced the buffalo with cattle, so they can replace the whale with a creature more easily controlled. Ton for ton, the vessels that cruise after menhaden, the small herring

(Continued on page 165)

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They're Farming the Ocean Now

(Continued from page 164)

that is kin to the lordly silver tarpon, bring home as much oil as ever was barreled by a New Bedford whaling ship. Men can replant the menhaden, or mossbunkers as fishermen scornfully name them, but it would be more difficult to replant whales.

True fish culture in the future, scientists say, will correspond to the fertilizing, seeding, and weeding of land crops. At Queens University, in Kingston, Ontario, Professor A. B. Klugh has succeeded in growing under artificially controlled conditions the marine plants and animals that contribute to the diet of salt water fish, and discovering the margins of temperature, light, acidity, and salinity in which aquatic plants thrive best. Similarly he measured the factors that govern the growth of the caepods, or water fleas that browse on that oceanic grass. Year after year he kept at work until he was able to raise successive crops of seaweed and "herds" of caepods. In salt water the fleas are the chief food of that variety of herring which we know as sardines; but we are eating those same herring when we eat codfish cakes. The cod, in turn, eat herring, and when there are not many herring on the market cod are also scarce.

ONE time, more than sixty years before Columbus sailed westward, herring disappeared from the Baltic and reappeared in the North Sea. Some undiscovered shift in the balances of ocean fodder was responsible. Historians have said that British sea power today—that means the cohesive element that binds together the scattered lands we know as the British Empire—was founded on that fish migration of the Middle Ages, but they cannot tell us what caused the migration.

English fishing boats began to appear on the North Sea in increasing numbers. Fighting ships were necessary for their protection. Gradually Russia and Germany began to rely for a part of their fish supply upon British fishermen.

Many times in the world's history the course of nations has been determined by some mysterious change in the food supply of fish, but men are not always able to see the results so clearly marked as in that tremendous political growth.

WHEN there is such a shift in a species of market fish today governments jealously seek an explanation and when fish migrate the scientific hunters stalk them. Johannes Schmidt began about a quarter of a century ago one of the greatest detective exploits of modern times. He set out to discover what became of the eels that left the fresh water streams of Europe each autumn to disappear into the sea. Those that were not caught in the rivers never returned, but each spring tiny eels, called elvers in the market places, swam into the streams and up to the headwaters to remain sometimes as long as fifteen years before they, too, were stricken with that urge to go to some undiscovered rendezvous in the ocean. Dr. Schmidt, with the aid of all the Danish ships that moved on the Atlantic, finally trailed the eels to their spawning beds in a valley in the floor of the ocean called Nares Deep, situated east of Florida and southeast of Bermuda.

A host of such mysteries is hidden in the ocean. Until they can be solved ocean farming must remain in a primitive state, advanced but little beyond the crude stage of mere ocean hunting; but as secret after secret is penetrated by the searching scientists the practical cultivators—the ocean farmers—will follow in their wake, bringing as reapers gigantic nets; and as seed, glass jars filled with myriads of tiny living creatures of many varieties, ready to be planted in the ocean.

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Piece of String Fixes Auto

(Continued from page 76)

like we'd run out of gas, but the tank gage showed more than half full even when I rocked the car to make sure that the gage was working. So I tickled the carburetor, but it wouldn't flood so I thought the pipe between the carburetor and the vacuum tank must be clogged and I took it off. I could blow through it easy enough. Then I turned on the shut-off valve at the bottom of the vacuum tank and gas began to gurgle out like water does from a small-necked bottle when you turn it upside down. That meant the vent pipe must be clogged up and sure enough, when I took it off the gasoline ran fine, so I blew through the curved vent pipe and a little green worm popped out and hit me right in the eye!"

"Maybe he thought it was a knot hole in a tree," laughed Gus. "You've certainly had some queer troubles. I'm glad nothing more serious happened."

"SERIOUS!" echoed Harbison. "Just you come over here and take a look if you want to see serious trouble." He reached in, turned the steering wheel of his car a trifle and pointed to the end of the steering arm.

"Holy smoke!" Gus gasped as he studied the string winding around the end of the steering arm and the drag link. "That certainly is serious enough. When did it break?"

"About two hours ago," replied Harbison. "I was driving along admiring the scenery when all of a sudden we hit a deep hole in the road and right after that I noticed that the steering wheel just turned in my hands without doing anything. I jammed on the brakes just in time to keep from going into the ditch. I thought we'd have to call for a service wagon, but Alec found a piece of heavy cord beside the road, cut some short pieces and looped them together and then bound them on as you see. You can bet we just crawled the rest of the way!"

"It's remarkable what you can do with just a piece of string if you know how," Gus observed. "That ends your trip till we can get a new steering arm."

"That doesn't worry me," said Harbison. "This was the end of the trip anyway, and I won't be going on another one for several months."

"THEN you won't need Alec any more," Gus said, and he turned to the little mechanic. "Alec, we can use you right along if you'd like to work for us. What do you say?"

"Well, Chief," replied Alec, grinning from ear to ear, "I've been kind of a rolling stone, but a rolling stone gathers no moss, so I guess I'll stick around and gather a little—I sort of like the looks of this outfit!"

Two Thousand Planes Built in Year

LAST year factories in this country turned out nearly two thousand airplanes, according to the U. S. Department of Commerce, more than sixty-five percent above the total production for 1926, reflecting growth in the popularity of aviation. For 1927 the Department's figures are: land planes, 1,857; seaplanes and amphibians, 105. Some idea of the size of this aircraft-building industry is seen, according to Postmaster General New, in the fact that, by way of comparison, only 700 steam locomotives were built last year, and but 300 Pullman cars. As for the automobile industry, air's greatest rival, there are now only eighty-five concerns turning out cars against 140 making planes—although the number of persons employed is fewer and plane production consequently lower. "But I now believe that I underestimated the number," says Mr. New, "when I predicted that 3,500 airplanes would be built in 1928."

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John Kenlon—Fire Fighter

(Continued from page 24)

protected iron columns supporting the roof. With the experience of his years as a fire killer, he knew the Equitable was about to collapse.

"All companies out of the building," was his command. Solicitude for his men, always an outstanding trait in John Kenlon's character, prompted him to order immediate retreat, and standing amid a shower of granite, he directed that retreat himself. It was one of the most masterly manoeuvres in modern fire-fighting. Inch by inch the men receded, clinging to their lines as long as possible. Finally, when it seemed that all were safely out, Kenlon learned that Deputy Walsh was still inside the roaring volcano. Kenlon himself was starting in to compel him to retire when the roof collapsed with an ominous roar, burying the gallant Walsh in the wreckage!

Kenlon, broken-hearted, narrowly escaped death himself as a huge meteor of granite crashed through the sidewalk at his feet. A moment later the southern wall collapsed. The Equitable was now an inferno, and the battle was on to save the billion dollars worth of securities in the vaults.

For the first time in the twentieth century, a New York Fire Chief put in a "Borough Call," bringing every available piece of apparatus in New York to the scene. The great nozzles, with pressure of 225 pounds, literally drowned the fearful blaze still raging around the vaults. And, though their walls were badly cracked, and their gates had to be hacked off, not a dollar of the billion was even scorched. Barring the loss of a gallant colleague, the new Chief had come out of his first great test with every element of victory in his hands. And during the last 17 years he has never lost a battle. Call it luck, efficiency, or what you will, John Kenlon is still the undefeated fire killer of the world.

"The fire of the future," says Chief Kenlon, "will be a sky-line conflagration, fanned by a terrific gale, leaping from one skyscraper to another a thousand feet from the ground."

"So far, New York has been lucky. But the recent Sherry-Netherlands fire, burning 600 feet in the air while the Department stood helplessly by, shows us that our present equipment is incapable of meeting the fire hazard of the future. A pressure of 300 pounds is needed to lift an effective stream to the fiftieth story of a skyscraper, and at present only a few of our lines can stand that pressure."

"Plans for the future? Certainly. The Department is working on them now. The high-pressure hydrant area is to be extended to 59th Street. Every building of the future will have its own high-pressure standpipe; enclosed elevator shafts for the exclusive use of the Fire Department; and adequate hose connections on each floor. Outside sprinklers will drop effective water-curtains around threatened buildings. The art of building fire-resistant structures will advance, of course. And the whole business of fire prevention will assume a new importance."

"Airplane fire fighting apparatus? Well, why not? After seeing the changes of fifty years in fire fighting methods, nothing's impossible."

Nothing's impossible! That's John Kenlon!

Their ship had foundered. They were marooned on a desert island—an extinct volcano—in the South Atlantic, 300 miles from the nearest shipping lane. They had neither food, tools, nor weapons, yet they escaped. How they did it will be told in next month's installment of this remarkable series, for the courage, knowledge and inventive skill of John Kenlon found the way. This chapter in Kenlon's career is the most amazing story of adventure and ingenuity we have ever published.—The Editor.



What Are YOUR Mistakes in English?

They may offend others as much as these offend you

IF some one you met for the first time made the mistakes in English shown above, what would you think of him? Would he inspire your respect? Would you be inclined to make a friend of him? Would you care to introduce him to others as a close friend of yours?

These errors are easy for you to see. Perhaps, however, you make other mistakes which offend other people as much as these would offend you. How do you know that you do not mispronounce certain words; are you always sure that the things you say and write are grammatically correct? To you they may seem correct, but others may know they are wrong.

Unfortunately, people will not correct you when you make mistakes; all they do is to make a mental reservation about you. "He is ignorant and uncultured," they think. So you really have no way of telling when your English offends others.

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Making Things Fit That Don't Fit

(Continued from page 47)

each of us talk to our friends about it and make vigorous complaint to dealers on discordant sizes and fits. Accept no excuse.

Nor should we heed the wails of esthetes and a few economic pessimists that America is already too uniform. Does it hurt us that standard gages are used more widely in manufacture and that the master gages of automobile makers register an accuracy down to millionths of an inch? Thanks to the master gages and the working gages checked by them, our cars have longer life and run more quietly and smoothly. Nor would it be a detriment if breakfast foods were put up in uniform packages and if some accepted rule prevented the undue abbreviation of nightshirts along with sheets and towels. The two latter items have indeed been dimensioned, removing from the joke category the tale of the tall legislator who demanded a law making hotel bedsheets long enough to cover his toes.

WHAT are the methods of attaining the new national economy?

The elimination of the superfluous is looked after specially by the Division of Simplified Practice of the Department of Commerce. A survey of the public will in buying is first made and then studied by a conference of manufacturers, dealers, and users. Finally a letter vote on the proposed project is taken and if 80 percent of all interests concerned approve, the project is adopted and published as a standard. It may be revised after a stated period, as six months or two years. There is no legal compulsion behind a rule, but it has been found that more than 82 percent of those interested adhere to the issued schedule. Doubtless observance is promoted by the fact that Uncle Sam is the biggest of all buyers and uses himself the standards and specifications developed by Government agencies.

The broad field of setting up standards in general is cultivated by the American Engineering Standards Committee, which represents virtually all industry and Government departments, and enrolls the leading engineers and scientists of the land. The method is similar to that outlined for the elimination of the superfluous by the Division of Simplified Practice. The scope of projects may be considered wider, involving all features of quality and size. Of 275 projects so far considered, 111 have been approved as national standards.

DURING the last year a table of "Preferred Numbers" was issued, putting the ban, let us hope, on some ornery fractions. Pipe fittings, bolts, and rivets also got what was coming to them. Dry cells that we use for radio and flashlights were commanded to conform in size and conduct. Fire hazard in electrical devices was lessened. How to test lubricating oil was a step toward aid of the motorist, now baffled by conflicting claims. A code for brick masonry was studied. Sizes of film and ways to take and project moving pictures were laid down and now, perhaps, pictures will be better; at least in the mechanical aspect.

Mathematical symbols have been told how to behave and mean what they say. The logic of preferred numbers applies to all commodities. It regulates size or dimension by a fixed percentage ratio, so that if any given size is known the rest in the series can be ascertained; thus, if curtain rods range from 1 to 10 feet in length with a 60 percent ratio of difference, we figure the whole series as 1, 1.6, 2.5, 4, 6 and 10—guided by a modifying rule. And the same figures can be adapted to lengths of rubber tubing, say, in the form of 10, 16, 25, 40, 60 and 100 feet.

One of the first guns in the modern war on diversity was fired jointly by the United States Chamber of Com-

(Continued on page 169)

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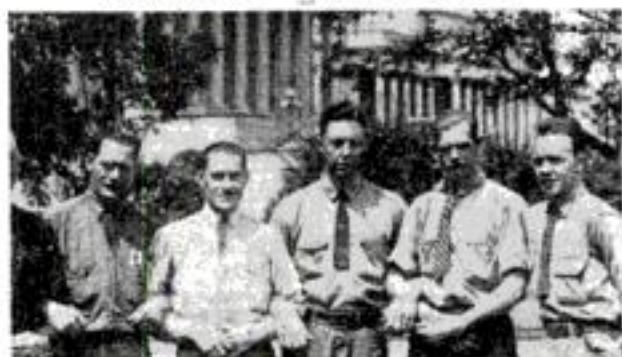
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Making Things Fit That Don't Fit

(Continued from page 168)

merce and the Department of Commerce. The target was a gang of 66 hard and desperate outlaws commonly known as paving bricks. At the first shot 55 bricks disappeared in a cloud of dust. Since then five more have gone into hiding and the remaining half dozen have surrendered and pledged themselves to be truly useful. After this victory another attack was launched and only one survivor each was left in the groups of rough face brick, smooth face brick, and common brick as against 36 to 44 varieties before. Beds, springs, and mattresses capitulated and were cut down from 78 to 4. Metal lath vainly resisted a reduction from 125 to 24 kinds. Hotel chinaware was cut from 700 to 160.

THE buyer of files and rasps need not pick and choose among 1,351 sorts as before: he is confronted today with only 496. Range boilers have shrunk from 130 to 13, woven wire fencing from 552 to 69, bed blankets from 78 to 12 and milk bottles from 49 to 9.

We all appreciate the reduction in paint and varnish brushes from 480 to 138 and wouldn't mind if they were a lot fewer. Sterling silver being cut from 190 to 62 alleviates the task of buying something for the bride. In plumbing several starts in the right direction have been made, as reducing brass lavatory and sink traps from 1,114 to 72. Lumber sizes have been more than cut in two.

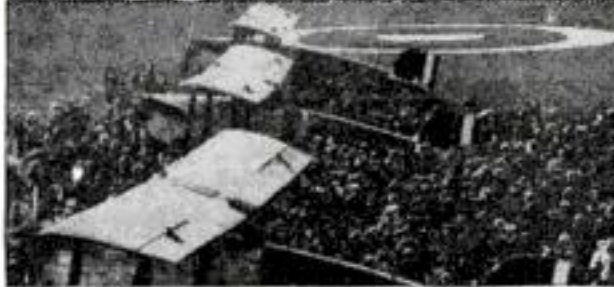
While rejoicing in the work accomplished, many of us feel impatient that our pet foes in diversity have not yet been trounced. For example, wire gages and machine screw threads. A dealer sells me a wire gage and I discover it is British. There is a merry conflict of screw threads between the domestic models termed S. A. E. and A. L. A. M. and U. S., not to mention the English variety and the metric type of the European continent. I am harassed enough by home screws and would be flabbergasted if I took my car abroad for a tour of the Old World. It is estimated that a foreign car imported here and aiming to cross our continent would be stalled at some point between Ohio and Nebraska by the loss of one bolt impossible to duplicate.

THIS brings up the fond dream of international standards. A stumbling block about the size of Mount Everest seems to loom in the way. We call it the metric system but the foreigner would term it the absurdity of inches, feet, and yards. Nevertheless a friendly contact between the organized standard-making experts of the various nations has been established and there is a pious hope that mankind will ultimately become wise enough to have one code of weights, measures, and standards. Science in general has already adopted the metric system and our foreign trade daily promotes its use. Within ten years the Germans have laid down more than two thousand standards.

England is said to be slower at the job than America and Germany, but is making progress and has issued 500 standards, which are especially important since they tend to become the code for the entire British Empire. France has established around 350 standards and has a fertile field left to cultivate, what with 3,800 models of piston rings, 250 types of batteries, and 60 sizes of tires made by one manufacturer alone. Soviet Russia has 400 standards under way. Neighbor Canada is inclined, on account of mutual trade interest, to cooperate with this country in a good many standards.

Europe has a slogan to "rationalize" industry in and between nations. There is a genuine movement behind the watchword, and the work for standards is an important part of it. The ultimate purpose is to make the world wasteproof, richer, and happier.

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What Is an Invention Anyway?

(Continued from page 59)

return to the man and the tire pump. His dreams of fame and fortune were crushed. We can sympathize with him, but we are more interested in why the patent was refused. It was because his device was not, in the official sense of the term, an invention.

Why?

In the first place, its elements—pump and tire—were not new. Second, the connection between them—mere application of pump to tire—was not new. And third, the result of their operation was not new. Yet none of these was claimed as new. What was claimed as new was the permanent attachment, in a workable manner, of pump to tire, and the operation of the pump without changing its position.

NOW, this attachment involved simply the mounting of one thing upon another, without producing any new result, and without bringing about any new interaction or increasing the efficiency of the means already employed for inflating tires. To bring parts together like this may be new, but it is held to be simply the exercise of mechanical skill. And mechanical skill is not of itself invention. A ruling by a Patent Commissioner some years ago is enlightening:

"It is well known that the mechanics, artisans, and laborers of the world are continually making an infinite multitude of new and useful contrivances, changes, and modifications in the affairs of life, and yet they do not dream of patenting them, for the reason that they are not the result of the exercise of the inventive faculty, but simply of the mechanical faculty."

Yet we should not conclude from the above that a combination of parts which have been previously used is never patentable. If from a rearrangement of parts there is produced a new interaction between them, or if the previous operation is simplified or increased in efficiency, then the rearrangement is—and the courts have so held—invention.

Suppose the man had contrived a tiny pump—say two inches long—which was placed altogether inside the tire. With a cap in place of the usual handle, and with a spring to eject the piston after each phase of its operation, such a pump could have been made to work itself.

AS THE wheel turned, if the pressure in the tire was low, the pump would be operated when the part of the tread next to the cap touched the ground and so pressed against the cap. By threading the inner end of the piston rod into the piston, the rod could be made adjustable—for example, to a length of two inches—so that whenever the tire was deflated to a level equal to the length of the piston and piston rod together, the pump would operate automatically. This would insure a prescribed minimum of air at all times, provided the tire had no leak. Of course, the pump would have to be so connected with the valve as to admit air into its cylinder from the outside.

We see at once that such a pump, while using old means, produces a new result—automatic inflation; hence it is patentable, and was so found by the man who actually invented it.

Most of us have no doubt heard the story of the man who "invented" the lead pencil with a tiny eraser on one end and made a million dollars. How much of this story is true it would be hard to say, but some of it is pure fiction, because the United States Supreme Court, in a celebrated case, held his patent void since there was no patentable co-operation between the eraser and the lead in the pencil. Merely placing the two together without creating any

(Continued on page 171)

This One



YFRU-U0Y-HT1B

What Is an Invention Anyway?

(Continued from page 170)

interaction between them was not invention.

Once upon a time a man saw a way to keep canals from freezing in winter and make them navigable the year round by heating their water with steam pipes. That was surely new and of public value, but a patent was refused because the idea had been anticipated "by bathtubs, wash boilers, and the like which have been heretofore heated by iron pipes, and by raceways where hot water has been poured upon the ice to thaw it."

As an instance of a patentable combination, we may take the tool for decapping bottles and opening tin cans. The back of the can-cutting edge is so rounded that it serves a double purpose—as a stationary fulcrum for the decapper, which overhangs and so protects both the cutting edge and the hand, and as a moving fulcrum for the can-opening blade. If the tool had the can opener at one end and the decapper at the other, with no cooperation between them, it would not be patentable.

WHEN an inventor has been refused a patent he can carry his case to the Patent Office Board of Appeals and if defeated there, to the Court of Appeals of the District of Columbia, or to a Federal District Court.

It often happens that an invention—for example, a part of a machine—falls within the scope of a broader and previous invention. Then the original patent for the complete machine dominates the subsequent patent for the part.

This means several things. The inventor of the part, even though he obtains a patent, is not entitled to use, manufacture, or sell his device without the consent of the owner of the earlier patent, so long as the earlier patent is unexpired. And if the later patent is to be utilized before the earlier one has expired, the owners of the two patents must come to an agreement for the mutual use of them. If, as sometimes happens, the dominating, or earlier, patent covers an impractical and unprofitable invention, and if the owners of both patents fail to agree on mutual use, then neither of them can successfully exploit his invention.

Here comes up the question of infringement—one of the most complicated aspects of patent law, involving extensive technical considerations. It is sufficient for us to note that the Patent Office may sometimes, in special circumstances where justice dictates, ignore previous patents and issue one to an inventor who may presently find himself sued for infringement by owners of the previous patent. The courts, however, seem to be of the opinion generally that the issue of a patent automatically does away with infringement. The reason the Patent Office may thus ignore previous patents is that the later invention also deserves protection.

MR. JONES invented a lock; but, being a busy man, delayed a year and a half before applying for a patent. Meantime Mr. Brown had invented the same thing and obtained a patent, so when Mr. Jones made application it was too late. Had Mr. Jones put his lock in use, he would have been held to be the rightful inventor. He would have been assumed to be trying out his invention, whereas when he let it remain idle for a year and a half, the assumption was that he had suppressed or abandoned it.

It is an advantage to apply for a patent as soon as possible after the invention is made, because that protects the inventor against competitors. However, it is not absolutely necessary to apply at once. Two years from the time the invention is placed in public use are allowed for filing.

A manufacturer of farm implements once hired a mechanical (Continued on page 172)

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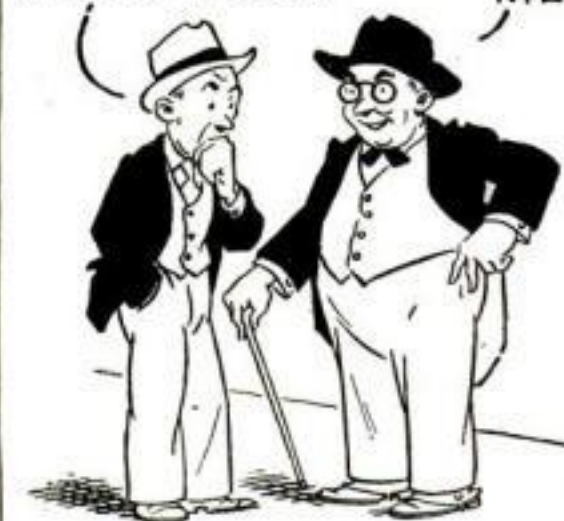
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What Is an Invention Anyway?

(Continued from page 171)

expert to generally improve articles made by the manufacturer. Sometime afterward the man was told to devise a particular kind of plow. He did so, and then obtained a patent on it. The manufacturer challenged the inventor's right to the patent. The court ruled for the inventor because he had not in fact been hired to invent the plow, but to do general work. If he had been hired specifically to invent the plow, then the invention and the patent would have belonged to the employer.

Robb's *Patent Essentials* explains that it has become a custom to make an agreement whereby the employer acquires the right to such inventions as the employee may make in the performance of his duties. When no such contract is made, the employer may be unable to acquire the title to the employee's inventions.

THERE is another important aspect of employers' and employees' rights. Many inventions are produced by men while using the time and equipment of their employers. In such a case an employer has the rights to manufacture the invented article for his own use, without regard to the inventor or to his patent. The inventor may sell or otherwise dispose of his patent, but the employer still retains these "shop rights."

An inventor is at liberty to sell or dispose of his patent as he pleases. A common practice is to sell to a manufacturer or agent a license to manufacture, sell, or use the invention. Frequently such a license conveys the exclusive right to the sale of the patented article, under stated conditions. In such cases it is usually required that a certain minimum of sales must be made and that these sales shall be made in a given territory. Provisions are also included for the revocation of the license if requirements are not met.

If the inventor wishes to patent his invention both in the United States and abroad, he must bear in mind certain requirements. In the United States a valid patent cannot be issued if a patent on the same invention has been issued in a foreign country as long as one year previous to the filing of the application in Washington. If the inventor has had his application pending in a foreign country for more than one year, and if he proposes to seek a patent in the United States as well, his United States patent must be the first to issue. If he specifies that his foreign application is pending, the Patent Office in Washington will usually give him preference so as to speed its own decision.

OF ALL the questions involved in patents and inventions perhaps the most interesting is, What is an invention? It has received various official answers, but the question has never been completely and finally settled, because it is too broad a term. Art, of which there are all sorts of definitions, is such a term. So is science and so is law.

Years ago the United States Supreme Court concluded:

"The word 'invention' cannot be defined in such a manner as to afford any substantial aid in determining whether a particular device involves an exercise of the inventive faculty or not."

As the matter stands today the courts are still struggling with the question, What constitutes invention?

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on *half* of the Keyboard

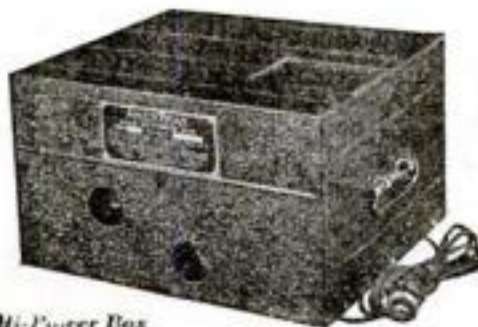
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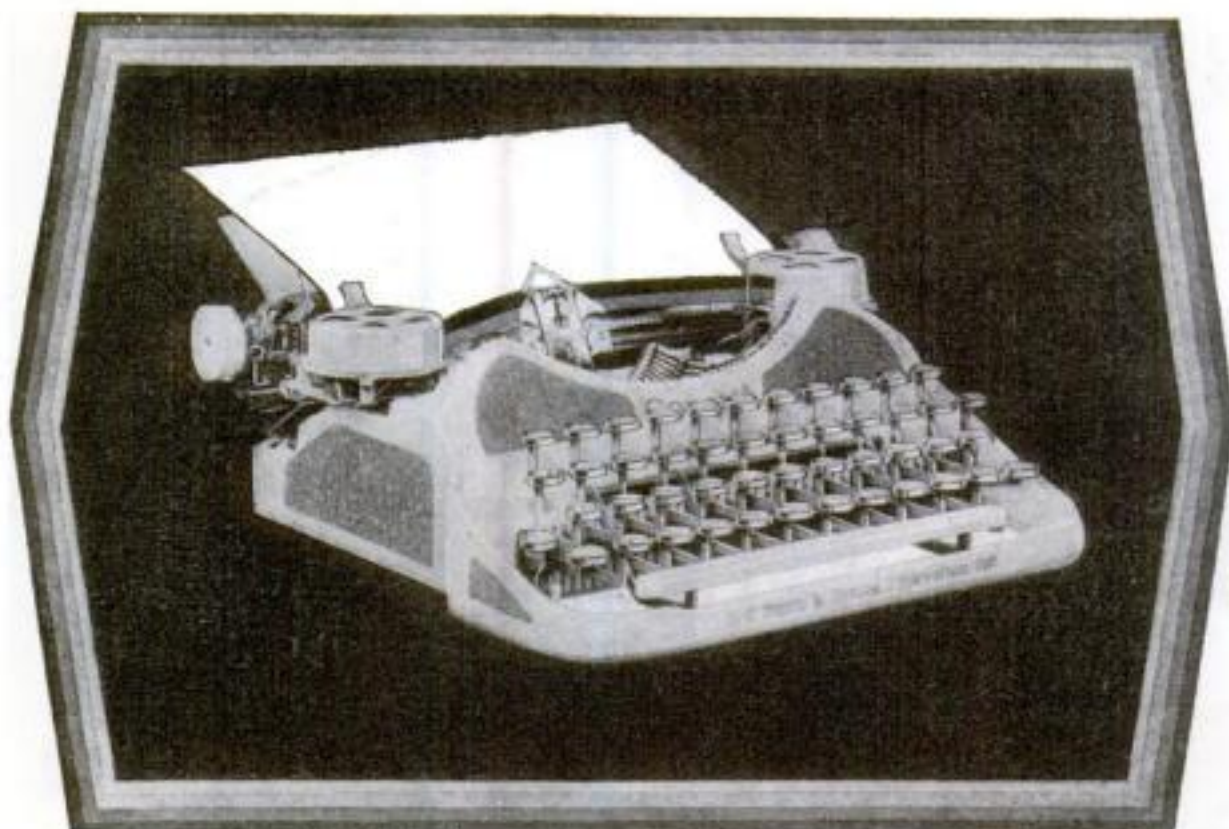
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South Sea Colony Reveals New Facts About Heredity

(Continued from page 21)

Thus, about ten years after the landing, Alexander Smith, last of the mutineers, was left with ten women and nineteen children on his hands.

Meantime, dramatic events had occurred outside of Pitcairn. What of Captain Bligh and his eighteen companions in an overloaded, twenty-three-foot boat, which the first wave threatened to swamp? With few provisions, and without sextant, timepiece or map, they set out on the seemingly hopeless struggle to reach a friendly Dutch settlement 3,618 miles away—a voyage that remains to this day a miracle of navigation. Through the terrible thirst of tropic days and through storms that kept them bailing in anxiety and horror, they sailed on for a month and a half and at last reached civilization.

England sent a man-o'-war with twenty-four guns and one hundred and sixty men who seized the mutineers remaining in Tahiti and returned them to London for speedy trial. The nine who had disappeared were reported dead. Twenty years went by before the memory was dramatically revived by the weird tale of an American whaling captain.

HE HAD stopped at an unknown little island to replenish his water supply. As he warily approached, ready for an attack by savages, what was his surprise to be hailed in English! The descendants of the mutineers welcomed him. He found that in their strange republic education was compulsory up to the age of sixteen. Women and men alike voted to elect the chief magistrate annually. Property was inherited, regardless of sex. Laws governed the people, who worshiped after the manner of the Church of England!

Alexander Smith had been a remarkable man. The son of an illiterate London lighterman, he had taught himself to read from scraps of printed papers which he picked up in the London streets. Strangely enough, among the things brought to the island was a Bible and a prayer book. With these, he perfected his reading and writing and taught the others.

From the first, this patriarch insisted on a careful record of births and marriages. Among the quaint entries in this historic book is the statement: "At the end of this year, we had increased the republic by the birth of seven children, three boys and four girls."

WHEN Smith died at the age of sixty-five, the population was 106 and there were twenty-six married couples. Later, American whaling ships touched the island with greater frequency, bringing new ideas with them. Whaling captains' wives, left there for several months, introduced Yankee customs.

About seventy-five years ago, the population had so increased that the islanders induced the British government to set aside for them another island, Norfolk. Whaling and shipping lemon juice to Sydney, Australia, are now the chief sources of outside income.

Dr. Shapiro's study of the Pitcairn Islanders will soon be published in America. It is expected greatly to strengthen the position of those scientists who believe that heredity alone, and not the fact that parents are related, is to blame when defective children result from such marriages. They do not advise the marriage of close relations. The danger of passing on a double strain of weakness, inherited by both parents from a common ancestor, is too great. But they no longer believe that relationship itself is sufficient to make the progeny defective.

In this new understanding of the laws which govern heredity, a strange tropical island and its Robinson Crusoe inhabitants have played an important part.

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LEFT: Nozzle end of Model T. The atomized oil is mixed with the scientifically determined correct volume of air, producing the right amount of heat with a minimum consumption of fuel. Note how spark is directed into oil vapor

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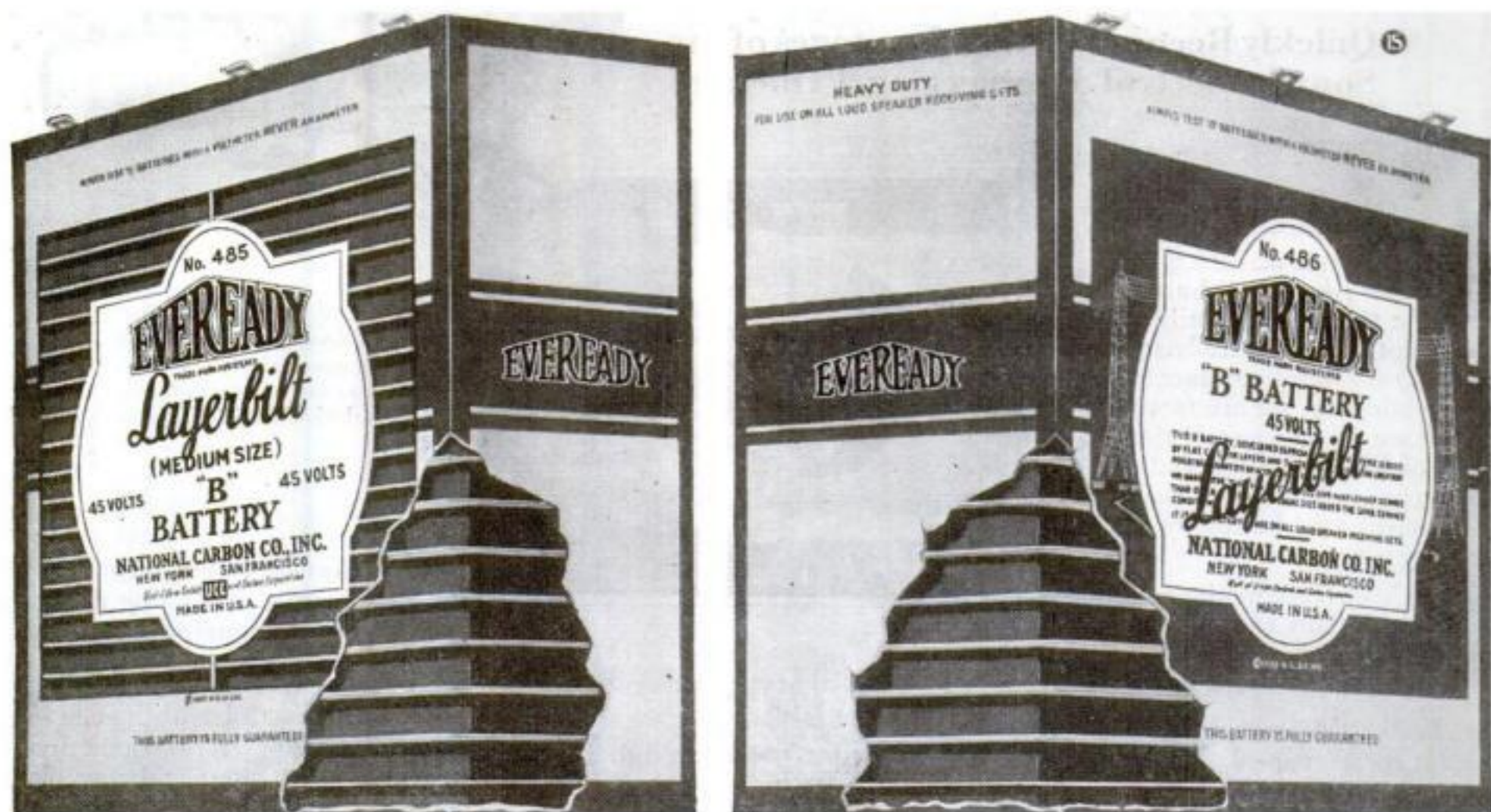
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To-day, power—electric power—is pretty nearly everywhere. Every year, the long stride of the giant transmission line opens fresh territory. Manufacturers are finding new opportunities outside our congested industrial centers. The job is marching to the man. Decentralization of our industrial system is transforming America.



More and more G-E motors are used every year to turn the wheels of our changing and developing industrial system. The same company which makes the huge turbines that generate power, also makes the MAZDA lamps, fans, and household appliances with which you are familiar through daily use. On all these products, the G-E monogram constitutes the same dependable assurance of quality.

To the small town, these humming wires bring a new industrial importance; to the manufacturer, they spell efficiency, as well as relief from high taxes and cramped quarters; to the worker, decentralization means a home of his own and a higher standard of living for his family. And it is the electric generator, the electric transmission line, and the electric motor which have made decentralization possible.

GENERAL ELECTRIC

**A Radiotron
for every purpose**

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*Power Amplifier Last
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- RADIOTRON UV-886**
Ballast Tube

The standard by
which other vacuum
tubes are rated



Look for this mark
on every Radiotron



Leading makers of radio sets recognize RCA Radiotrons as the standard vacuum tubes for all uses in both transmitting and receiving instruments. They specify them for tests, initial equipment and replacement.

Radiotrons are the heart of the receiving set. To maintain fine reception, the vacuum tubes in your set should be replaced with new Radiotrons at least once a year. Do not use new tubes with old. Best results are obtained by changing all tubes at one time.

RCA Radiotron

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